Modern Refrigeration & Air Control

Vol. 62 No. 732 MARCH, 1959 Price 2s. 6d. monthly

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7 TO 20-STATION MULTIPLATE CABINETS FOR FREON, AMMONIA, OR BRINE OPERATION, also
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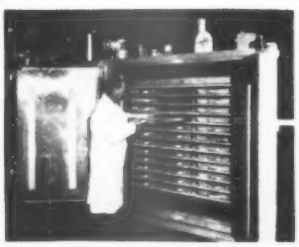

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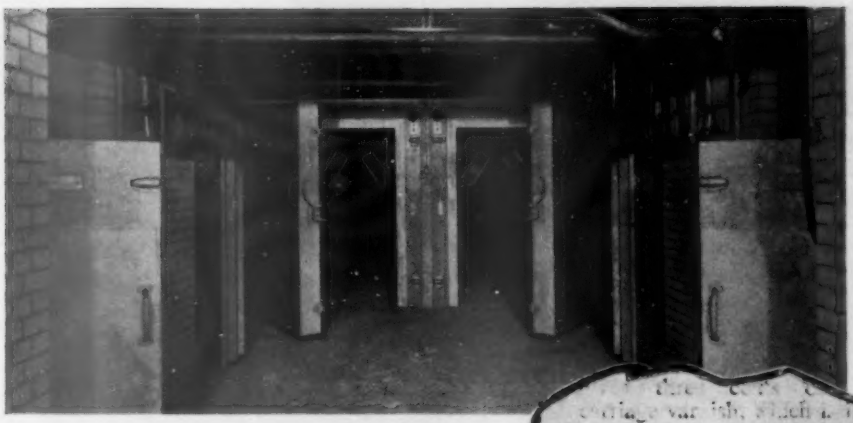

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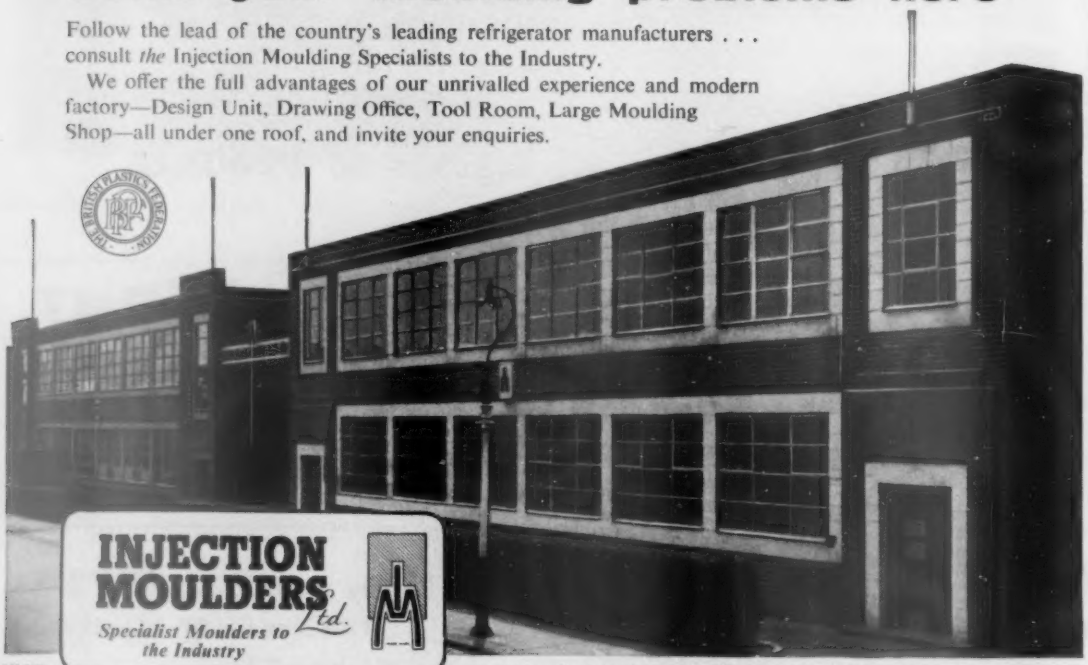

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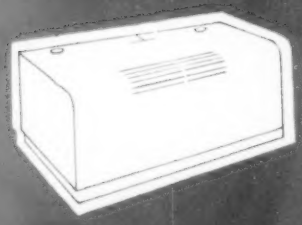
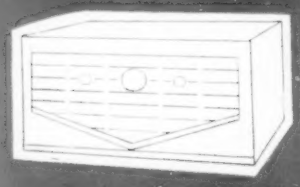
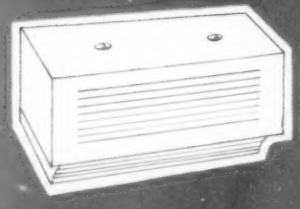
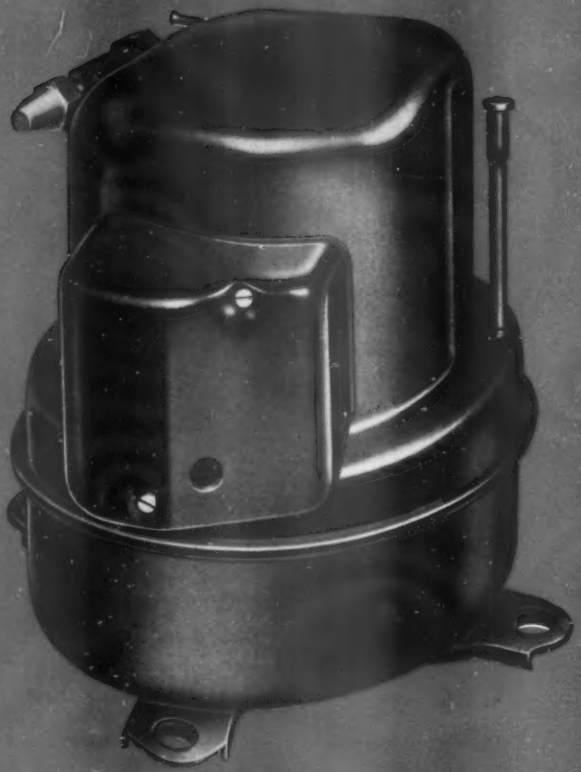


Model S2T16, ½ H.P. Motor Compressor, single cylinder

for ROOM AIR







Motor Compressors, twin cylinder, Model B7613, ¾ H.P.; Model B1616, 1 H.P. and Model B32T16, 1½ H.P.

Tecumseh

Motor Compressors

CONDITIONERS

A full range of hermetically sealed motor compressors with motors suitable for Three Phase and also Single Phase electric supply, manufactured under an exclusive licence from Tecumseh Products Company, U.S.A. is available for air conditioning engineers and manufacturers of room air conditioners.

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The ½ H.P. model S2T16 compressor is a single cylinder capacitor start type, an ideal combination of compactness and refrigeration capacity. With the same internal spring mountings as used in domestic compressors it provides the last word in quietness and efficiency at the lowest possible cost. Available with either low or high starting torque motor and suitable for use with Freon 12/Arcton 6.

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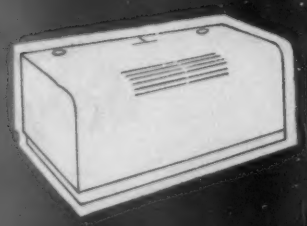
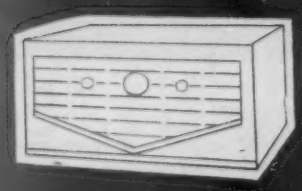
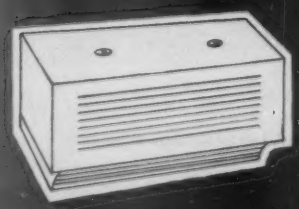


for ROOM AIR





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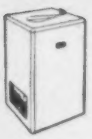
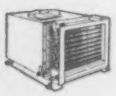


Drinking water coolers



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P.2263

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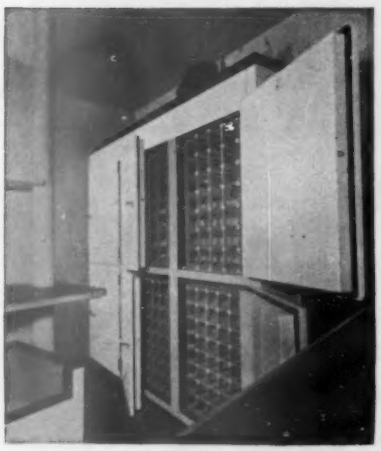
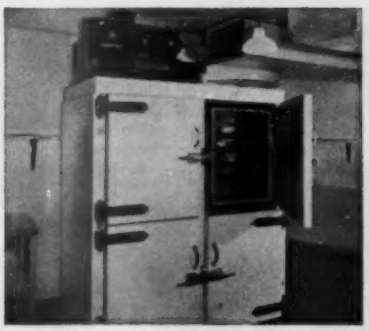


FRIGIDAIRE FOR THE BALCONY!

The kitchen on this floor is very fully equipped with special Frigidaire service cabinets designed for quicker, more efficient service. In the balcony bar, there is a special wine-cooling cabinet and also a standard beverage cooler.



FRIGIDAIRE ON THE GROUND FLOOR!

The kitchen on this floor—for serving diners on ground floor level—contains two standard upright service cabinets, besides a stainless steel cabinet with service compartments for cooling salads, hors d'oeuvres, smoked salmon, ice cream, etc. The bar on this floor, too, is equipped with a special wine-cooling cabinet.

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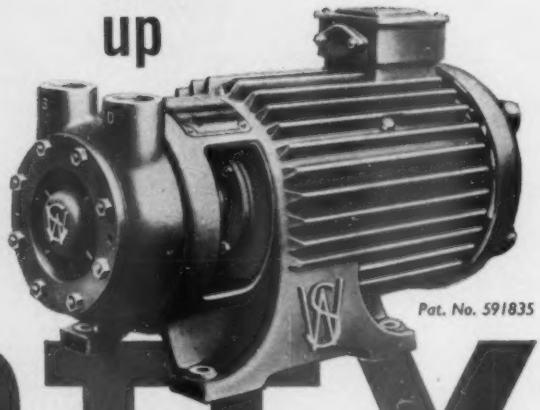
Readily adaptable for wide variations of head with little change in capacity—and no risk of overloading at maximum head conditions



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The simplest and most economical pump available for small capacity pumping to high heads

Available with the new WS FLAMEPROOF motor, carrying Buxton certificates for Group I and II gases

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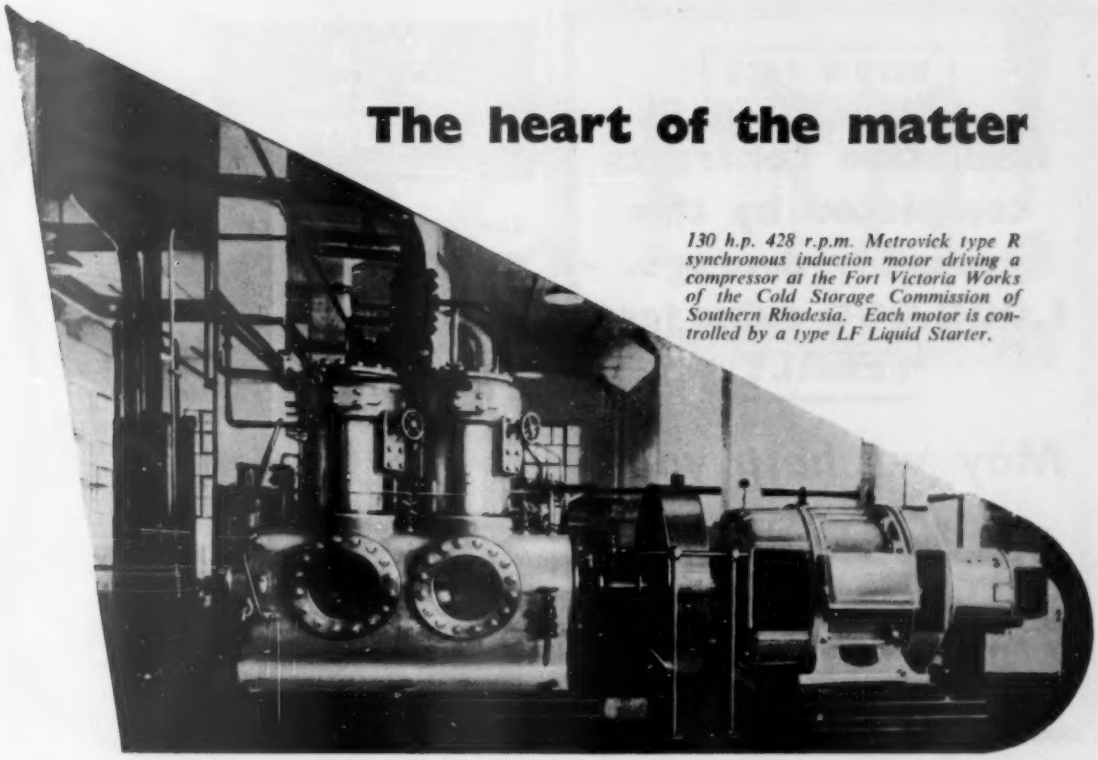
PUMPS · COMPRESSORS · HEAT EXCHANGE EQUIPMENT

NEWARK NOTTS.

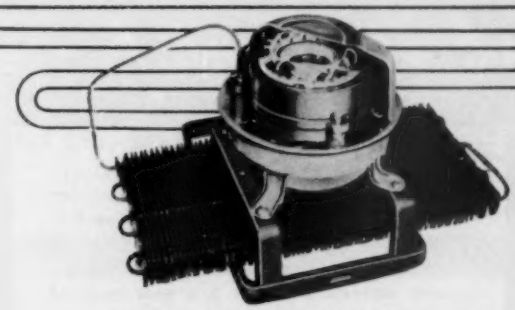
P 2222

The heart of the matter



130 h.p. 428 r.p.m. Metrovick type R synchronous induction motor driving a compressor at the Fort Victoria Works of the Cold Storage Commission of Southern Rhodesia. Each motor is controlled by a type LF Liquid Starter.

In refrigerating plant it's the motor that matters. Metrovick motors are designed by engineers with first-hand knowledge of the refrigeration industry. They do not stop at B.S. Specifications. Maximum reliability with minimum maintenance is the specification followed. Whatever the size of refrigerating plant, it pays to install one of the range of Metrovick motors.



A Metrovick fractional horse power stator and rotor unit sealed into a Lec Refrigeration Ltd. refrigerator compressor.

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A· A.E.I. Company

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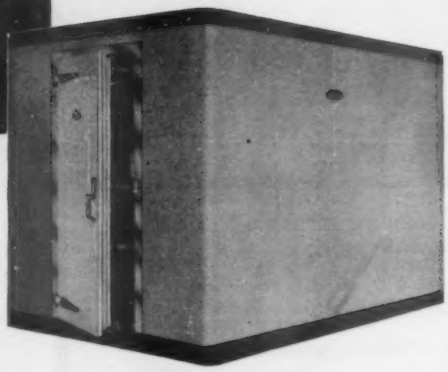

250 cu. ft. Coldroom. All-white coach-built finish.
Applications for agencies invited.

Whatever you pay for your refrigeration plant, it is so much money wasted unless it is absolutely reliable at all times.

FROZT-ED-AER equipment is both reliable and economical. There is a wide range of refrigerators for storage and display [or storage, display and deep freeze cabinets] at reasonable prices. Please write stating your business.

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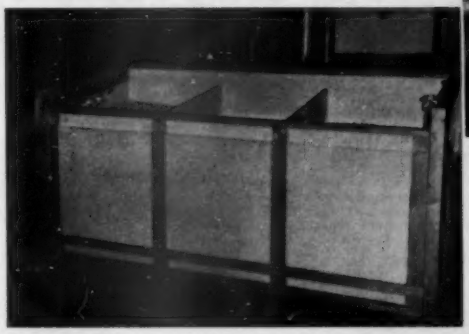

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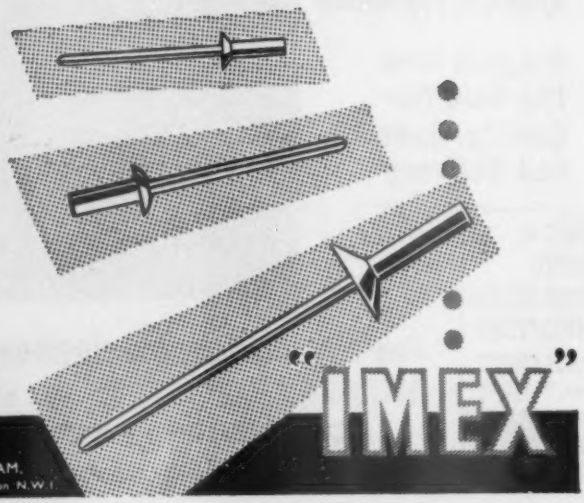

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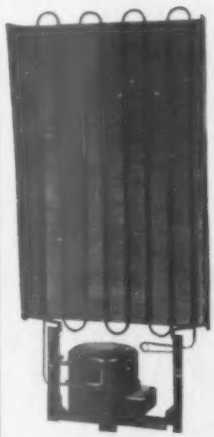

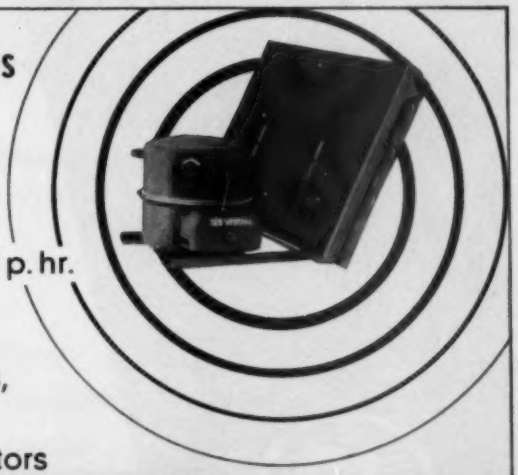

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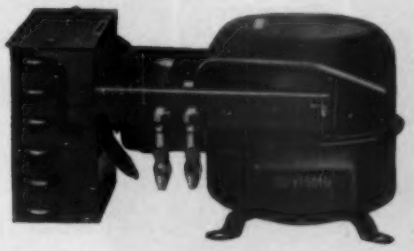

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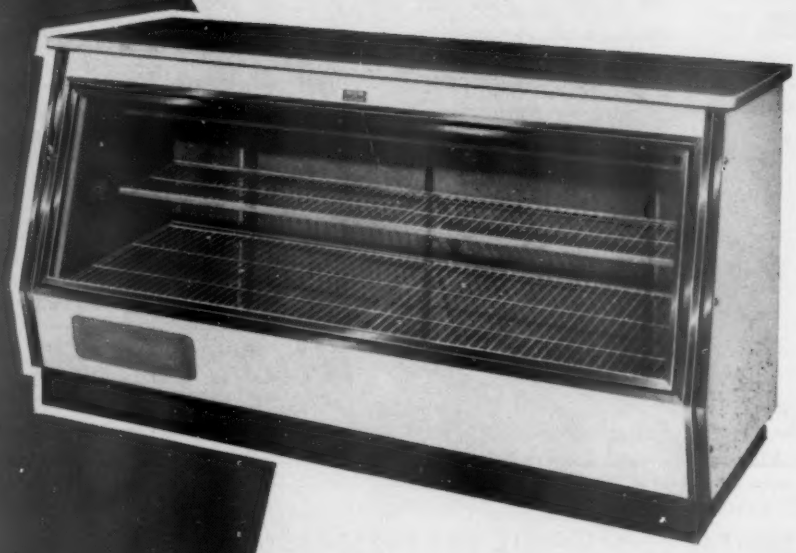

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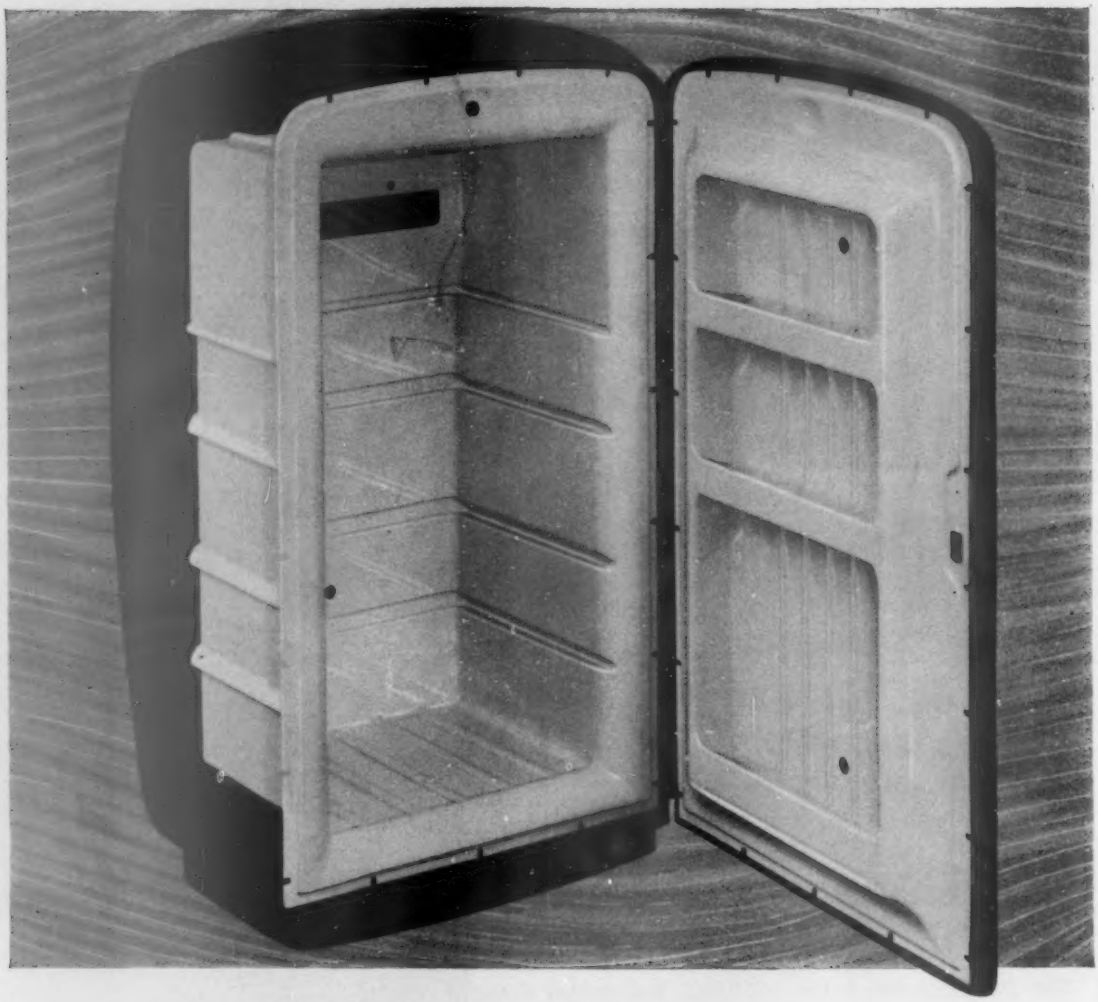

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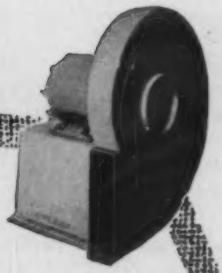

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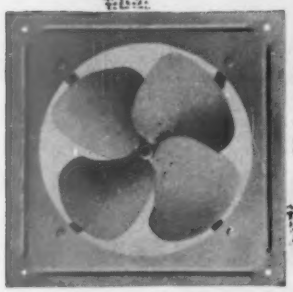

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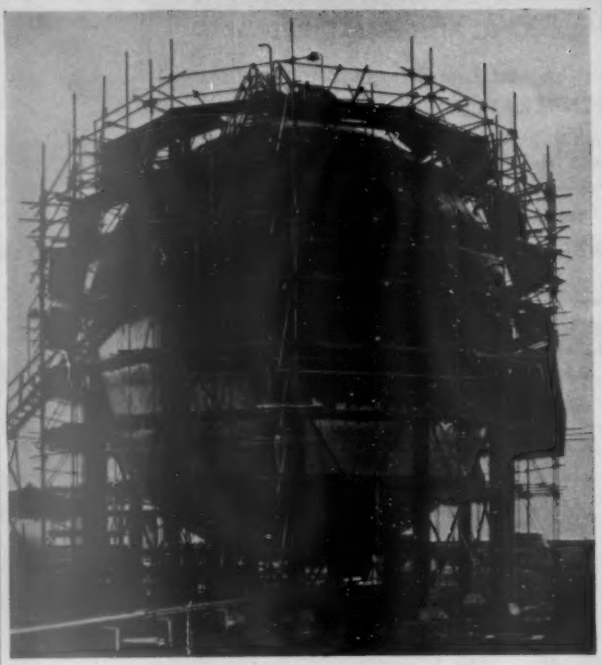

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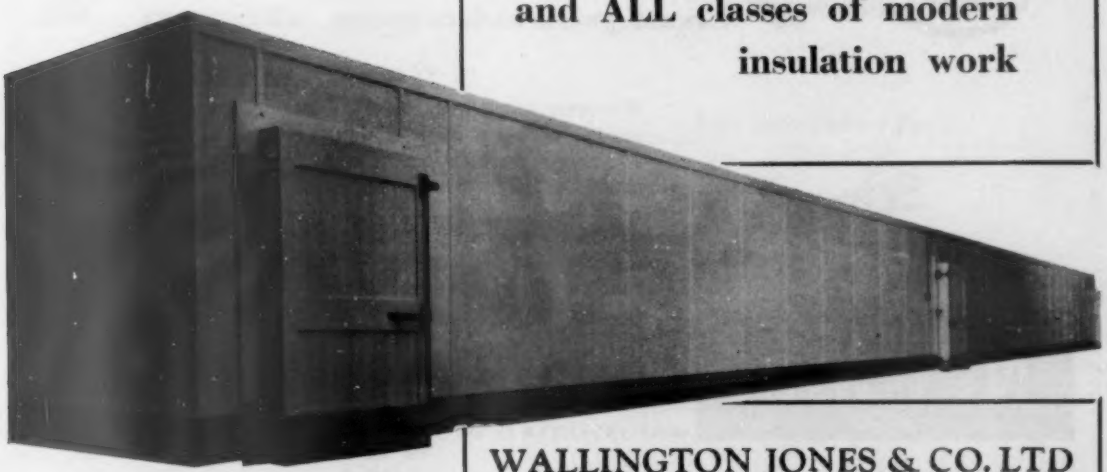

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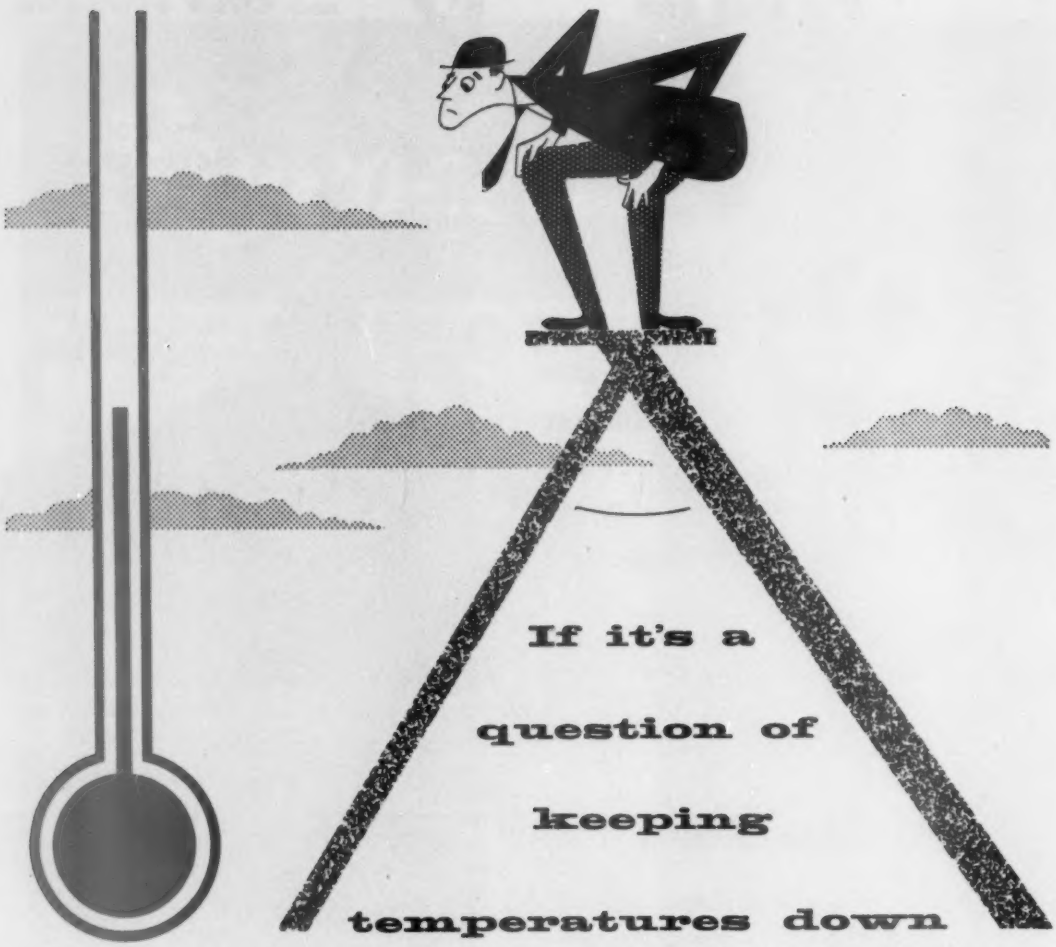

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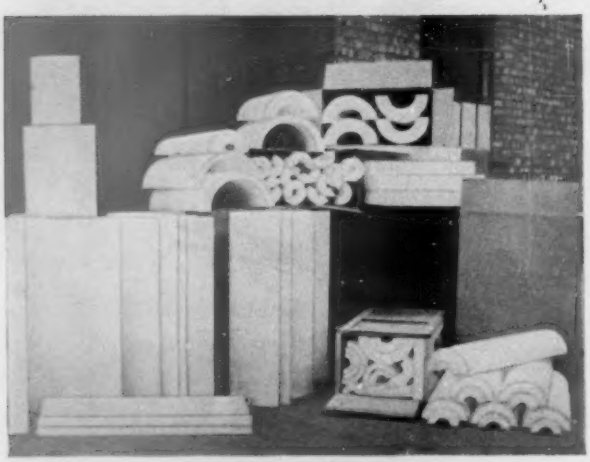

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REFRIGERATION ENGINEERS required by KELVINATOR LTD. for maintenance and installation work in the Greater London area. Good salaries and conditions with Pension Scheme are offered to suitable applicants. Apply to Personnel Officer, Kelvinator Ltd., Hudson Motors Building, Great West Road, LONDON, W.4. 1161

REFRIGERATION AND AIR-CONDITIONING. Engineer required for specialised work in new industrial fields. Must be fully experienced and capable of designing and estimating on own initiative. Responsible position with prospects in growing Company. Full particulars to Box 1164. 1164

REFRIGERATION. Qualified senior engineers for interesting and varied industrial sales engineering work. Excellent prospects for energetic men with or without previous experience and holding H.N.C. or better. Full details age, experience, salary, to Box 1166. 1166

REFRIGERATION ENGINEER wanted for service and installation on refrigeration and air-conditioning plant. Applicants should be willing to travel and preference will be given to men with experience on automatic industrial plant. Good scope for man with ambition and initiative, keen to progress in new fields.—Denco Miller Ltd., Holmer Road, Hereford. 1168

REFRIGERATION Service Engineers required by Agents for first-class equipment. Somerset area. Experienced Domestic and Commercial up to 5 h.p. Clean driving licence. Permanency. Applications treated confidentially.—H. S. Phillips & Son Ltd., Langford Road Works, Weston-super-Mare. 1169

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ARTICLES WANTED

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WANTED, 5 x 5 YORK ammonia compressor. Must be in good condition.—Box 1162. 1162

WANTED, Sectional Cold Room, 1,000 c.ft., temp. −10° F., 10 gross per hour Lolly Freezing Tank with condensing unit.—P. S. & E. M. Eynon, Windsor Creameries, Pendine, South Wales. Tel: 233. 1171

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REFRIGERATION COMPRESSORS. Several two-stage by Hall and Sterne's, complete motors. Several 6 in. x 6 in., by Hall, Sterne's, Lightfoot; 5 in. x 5 in. Hall, York, G. & J. Weir; 4 in. x 4 in., York, Hall, Sterne's, Weir, Lightfoot, "Freon" VT7 10 h.p. and 7½ h.p., also 3, 4, 5 and 7½ h.p. "Freon" Compressors by Sterne's, York, Hall, etc. Large stockists. Keenest prices in the trade. Export orders receive special attention. Send in your enquiries.—Alfred's Ices (1954) Ltd., 1-5, Hall Place, Church Street, London, W.2. Telephone: PADdington 6619/6610. Telegrams: ICEFRIGO LONDON, W.2. 830

600 C.FT. Cold Room Stancold Box, lined inside and out with galvanised sheet, 6 in. cork insulation, fitted Searle Bush low temperature cooler LT 85, Lightfoot 1 h.p. water cooled condenser unit water defrosting, capable of maintaining temperatures down to 20° F. by thermostatic control. New November, 1956. Perfect condition, £625.—Box 1091. 1091

REFRIGERATING Units comprising the following: 5 h.p. S.A.V.T. 4 Lightfoot compressor—Air-cooled condenser—dynamo and fan mounted together with 5 h.p. Wisconsin petrol engine and completely contained in metal cabinet with instrument panel fitted with gauges and dynamo control. £90 each ex. works. These units could be converted to suit mains electricity. Apply Polarcold Ltd., Congleton, Cheshire. Telephone: Congleton 2401/2. 1177

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MODERN REFRIGERATION

and Air Control News

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and ICE AND COLD STORAGE

Established 1898

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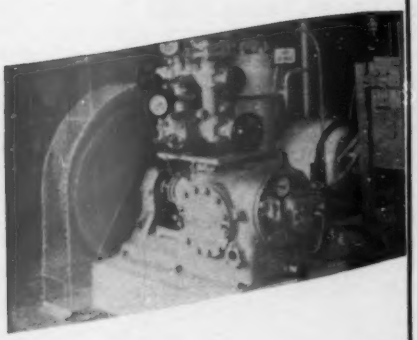

MODERN REFRIGERATION overseas

The world-wide circulation of this, the original and oldest Journal of the British Refrigeration Industry, carries "MODERN REFRIGERATION" by postal subscription into the following countries:—

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"M.R.", now in its 62nd year of publication, has built up for its overseas readers special subscription and sales agencies in all the above territories.

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March, 1959

Editorial . . . .

Boom Industry
Giant Plastics Moulder
High Velocity Air-conditioning

● Many refrigerator makers are wondering to what heights the present boom will soar with the arrival of spring—and the Ideal Home Exhibition. If the recent astronomical sales have been achieved during months of smog, they ponder, what will the coming of higher ambients bring in the way of increased public interest ? Something quite phenomenal, is our guess. Figures released by the Electricity Council of sales of new domestic appliances by area electricity boards show the tremendous impact which the relaxation of credit restrictions has had on demand.

● A considerable amount of credit for the above state of affairs (in which public acceptance of the fridge in the U.K. has been pushed up from 10 to 13 per cent. in the space of a few months) must, of course, go to the B.R.A. and to DoRDeC on account of their successes in educating housewives through the national and women's press. A further step in this direction was taken on the 26th *ultimo* when the second " Top Eight " show was held at the Hungaria, London. The eight leading manufacturers of domestic refrigerators linked with the presentation of their new 1959 ranges a special theme designed to show the British housewife how much the new models can help her in 1959. As DoRDeC points out, up till now the British housewife has been slow to realize the value of domestic refrigeration in the home. Record sales in 1958, however, indicate that at last the ice is breaking. During the year refrigerators were installed in 58 per cent. more homes than in 1957, but 87 per cent. of British homes are still without. Mrs. E. M. Braddock, M.P., opened the show which was admirably staged and extremely well attended. Mr. Eric G. Rowledge was a perfect host.

● It is to be hoped that the solidarity which B.R.A. has built up within the industry will not be weakened by counter moves which have been proceeding in Kingsway.

● The current period of high sales of fridges has been grasped by several newcomers for the introduction of their models on to the U.K. market; these makers include Ada (G.B.); AEG (Germany); Flavel (G.B.); Indes (Italy); Mersey Engineering (G.B.); Saer (Italy); Sterling (G.B.); Universal (Germany).

● The British plastics industry is revealing every bit as much resourcefulness as its American and Continental counterparts and a not inconsiderable part of this urge to expand comes, we are proud to say, from the refrigeration industry. Thus, it is that a new giant injection moulding machine installed at the Southend factory of Ekco Plastics Ltd., and enabling Britain to produce plastics mouldings in thermoplastics materials bigger (weighing up to 12 lb. or more) than anything produced in these materials in this country before, has as its first job the manufacture of refrigerator liners. Thermoplastics materials, such as polystyrene, polythene, cellulose acetate, etc., are widely used for certain kinds of household articles where their strength, pleasing appearance and resistance to kitchen hazards make them particularly suitable. Previously, large articles, such as the inner linings of refrigerators, have been produced in thermoplastics by forming sheets to the required shapes, and then drilling, punching, etc., as required for the fitting of other parts. Now complete assemblies can be moulded in one operation, just as easily and quickly as small articles like sink tidies or soap dishes. Ekco Plastics have the only machine in the country producing these large mouldings, and it was produced by R. H. Windsor Ltd. of Surbiton. Its first job is the making of complete inner linings in polystyrene for the new 3 c.ft. Frigidaire refrigerator, announced for the first time last month.

● In the year 1935, nearly a quarter-century ago, a British institution*, serving the heating and ventilating industry, held a papers meeting on the flow of air in small conduits. Being written by a worker in pure research it had no declared application, but the fact that it was interesting to heating and ventilating engineers indicated that it might be a portent of things to come. Heating engineers foresaw the possibility of putting hot air through pipes instead of water and ventilating engineers realized that ducts sized for economical operation were bulky ; their hybrid, the air-conditioning engineer, was in the embryo stage due to the growing realization of need for controlled air-conditions in heated spaces. The permissibility of drastic reduction of duct sizes, with inevitable increase of power and noise, presented a then insuperable problem. The employment and intensive treatment of primary air, having kinetic energy as well as quality, had to await development.

● In the cycle of development which is all too frequent, the ideas of that inventive race, the British, go to other countries for evolution and creation of fashion after which they are reintroduced to us. Small as the world has become, ideas and designs from abroad tend to appear better than those at home. The British idea appeals to other countries ; the fully-pledged product developed abroad from that idea appeals to the British after having been through the stages of grooming and productivity.

* Journal I.H.V.E. 1935 p.94

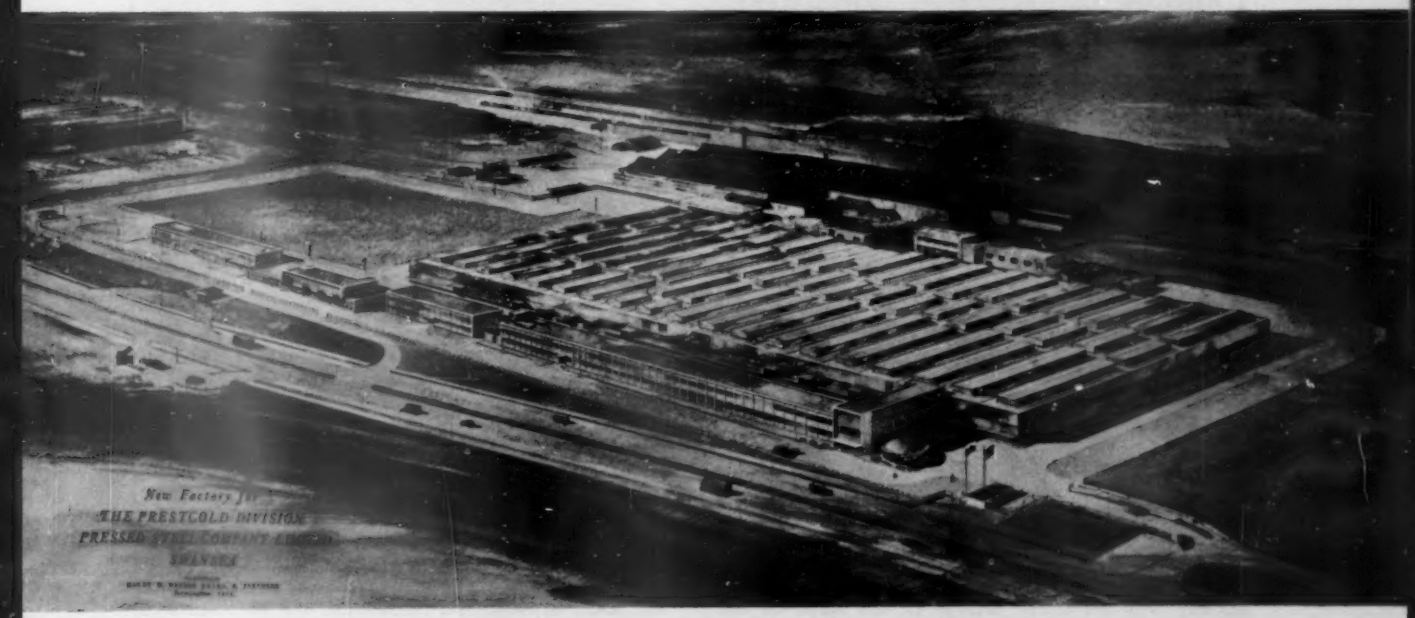
● The psychology underlying this is not a mistrust of one's own kind, but a broadening of experience and a combination of all the talents, not least of which is the boldness to create a demand where economic considerations appear unfavourable. Local or national resources which appear impracticable under one set of conditions become the magic carpet to success in another environment and development leads to success everywhere. This appears to be the case with the high velocity air system in modern air-conditioning which is enjoying such widespread acceptance. He who makes bold to design a revolutionary system does well to have international appreciation of merit.

● Talking of air-conditioning reminds the writer that he had the chance recently of seeing the interesting little booklet on The Rumford Club. This dinner-discussion club, concerned with the application of science to practice in the use and control of air, was founded in London by Mr. Bernard C. Oldham in the spring of 1947. During his visit to this country for the centenary celebrations of The Institution of Mechanical Engineers in June 1947 the father of air-conditioning, Dr. Willis H. Carrier, was entertained at lunch by the club at the Hungaria Restaurant and was made an honorary member. Meetings at four to six week intervals between Michaelmas and Easter enable engineers and scientists to meet on neutral ground and discuss any problems of interest however abstruse, controversial or topical, free from any competitive or opportunist spirit, welcoming correction or contradiction as much as endorsement, without favour or fear of publication. Most of the meetings for the first 10 years were held at the Waldorf Hotel ; latterly they have been at the Criterion in Piccadilly.

● Count Rumford (1753-1814), the pioneer in the application of science to practise, after whom the club is named, took a leading part in the founding of the Royal Institution of Great Britain in which he endeavoured to achieve the union of pure and applied science ; he was its first secretary. His hopes in pure science were fulfilled in the early 19th century by men such as Davy and Faraday, but his more practical intentions had to wait until the 20th century for the D.S.I.R. and The Rumford Club.

PRESTCOLD'S SWANSEA FACTORY

Architect's view of the new £5 million Prestcold factory at Swansea. The total site covers more than 50 acres, of which the factory and ancillary buildings will ultimately occupy approximately 660,000 sq. ft., the factory building itself being approximately 520,000 sq. ft. The new factory will ultimately accommodate the entire production of "Prestcold" refrigerators and refrigeration equipment—which are at the moment produced partly in Cowley and partly at Theale, near Reading. At the foundation stone laying last month by Mr. John Rodgers, parliamentary secretary, Board of Trade, presided over by Mr. H. A. H. Bellhouse, deputy-chairman, Pressed Steel, and Mr. J. R. Edwards, managing director, it was stated that the company's licensing arrangements with the Whirlpool-Seeger Corpn., U.S.A., had been strengthened. This is particularly interesting in view of the fact that Whirlpool are in the forefront of thermo-electric development in the States.



NEWS OF THE MONTH

Refrigeration and A-c. Exports.—During January, 1959, air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £740,931 weighing 1,207 tons, was exported from Great Britain. Comparable figures for January, 1958 were 697 tons, worth £498,801.

* * *

Exports' Analysis.—Of the 1,207 tons of air-conditioning and refrigerating plant worth £740,931 exported by Great Britain in January— quoted in the preceding paragraph—125 tons went to the Union of South Africa, 50 tons to India, 74 tons to Australia, 30 tons to New Zealand, 38 tons to Canada, 234 tons to "other Commonwealth countries," 27 tons to Eire, 14 tons to Sweden, 298 tons to Western Germany, 25 tons to the Netherlands, 16 tons to Belgium, 3 tons to France, 23 tons to Italy, and 250 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during January, quoted in the first paragraph, commercial refrigerators accounted for 353 tons, worth £192,711, industrial plant and equipment for 140 tons, worth £92,511, refrigerating equipment and parts, including parts of commercial refrigerators, for 463 tons, worth £277,041.

* * *

Exports of Small Refrigerators.—During January, 1,054 tons of complete refrigerators and domestic refrigeration equipment, were sent overseas from Great Britain. These exports were worth £670,090. The 1,054 tons comprised 66 tons to the Union of South Africa, 16 tons to Rhodesia and Nyasaland, 40 tons to India, 27 tons to New Zealand, 499 tons to "other Commonwealth countries," 15 tons to Sweden, 1 ton to Western Germany, 1 ton to the Netherlands, 3 tons to Belgium, 36 tons to Italy, and 351 tons to "other foreign countries."

* * *

B. R. A. Luncheon.—The British Refrigeration Association announces that its annual luncheon will take place on Friday, March 20, at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2. Mr. John Rodgers, M.P., has accepted an invitation to attend. He is the minister at the Board of Trade specially responsible for bringing new industries to areas which are "black spots" for unemployment. The chairman will be Mr. Eric G. Rowledge (senior director, Prestcold Division of the Pressed Steel Co. Ltd.), chairman of the Association.

* * *

Liquefied Gas Distribution.—The February lecture of The Low Temperature Group of The Physical Society was extremely topical in the light of the success attending the *Methane Pioneer* shipment. The distribution of liquefied gases in commercial quantities leads to a number of interesting problems, many of which are not obvious at first sight. Transporting gas in the liquid state has, in many cases, technical and economic advantages. Most users require gas at about ambient temperature; thus a producer wishing to exploit the liquid route must provide the user with equipment capable of generating gas under predetermined conditions of pressure and throughput, said Dr. T. J. Webster, British Oxygen Research and Development Ltd. A fully integrated scheme for the distribution of a liquefied gas involves a number of unit operations such as the pressurizing of vessels containing liquefied gas, the transfer of liquid from vessel to vessel by gravity and pressurization, or by pump, and the evaporation of liquid to produce gas at pressures up to 2,000 lb/in^2.

* * *

Dry Ice in Kano.—Manufacture of dry ice has begun in a factory opened by a new concern, the Nigerian Carbon Dioxide Co. Ltd., at Kano, the industrial and commercial centre of Northern Nigeria. The company will be run by London & Kano Trading Co. Ltd., one of the three oldest companies in Kano—established 1904—and has financial backing from the Northern Region Development Corporation. Production of dry ice will revolutionize the transport of foodstuffs, not only in Northern Nigeria, but throughout the Federation.

* * *

Freezing at Sea.—A fish factory trawler, the *Fairtry II*, was launched from the yard of Wm. Simons & Co. Ltd., Renfrew on January 27. The vessel, which will shoot her trawl from the stern, has the latest fish filleting and processing equipment on board, and will be capable of handling 30 tons of fillets in 24 hours. The main product of the catch will be "sea fresh filleted cod" but there are two by-products, oil and fish meal. *Fairtry II* is the second of a fleet of three ships, the original *Fairtry* being completed four years ago at Aberdeen, while the *Fairtry III* is now building at the Renfrew yard. Owing to the considerable advances in processing the ship will be able to stay at sea for more than three months.

* * *

Electrical Exhibition.—Details of two great features to be seen at this year's Electrical Engineers Exhibition, which Lord Brabazon opens at Earls Court on March 17, have just been announced. The first of these is the world's largest electric clock while the second is a 5,000 sq.ft. exhibit on the first floor devoted to the most modern and effective methods of shop window lighting. The clock, from the Synchronome Co. Ltd., of Alperton, Middlesex, will be suspended

from the roof of the main hall and will be controlled and kept to perfect time—by the standard Synchronome master clock on the ground floor.

* * *

New Australian Reefers.—Newly-designed refrigerated rail wagons are being used in Central Queensland this year to carry fish, milk and other perishable goods over the 378 miles distance from Rockhampton to Blackall on a twice-weekly service. Refrigeration methods on long distance trains—customary in Queensland—have been subject to investigation for some time. Since major technical problems have now been overcome, wider use of this type of rail transport throughout the State is expected.

* * *

Hotelympia, 1960.—Hotelympia 1960, the International Hotel and Catering Exhibition, will again be held at Olympia, London, and will be open from Tuesday, January 19 to Thursday, January 28. Even at this advanced stage it is possible to announce that most of the famous manufacturers of catering equipment, etc., have already booked stands. The traditional salon culinaire, junior salon, demonstration theatre, and the table d'honneur, will again be staged together with trade association conferences and social gatherings associated with Hotelympia.

* * *

New Refrigerated Stores in Luxury Hotel.—Under an extensive rebuilding scheme for service departments two new coldrooms and a refrigerated white wine cellar have been built at Grosvenor House to replace and augment existing cold storage arrangements. The meat coldroom, in which game and hundreds of raw chickens are stored, is refrigerated at 28° F. The second coldroom is used for storing milk, cheese and hams and is therefore controlled at the higher temperature of 38° to 42° F. The wine-cellar is now twice its former size and the white wine chambers, refrigerated at 45° F., have a capacity of 18,000 bottles. They are stored at this temperature so that large quantities of stock can be quickly sent to any of the hotel's sub-cellars. The mechanical consulting engineers were Winton, Thorpe, Tunnadine, & Partners. The sub-contractors for these cold chambers were Metropolitan Refrigeration Ltd., using York plant.

PICTURE OF THE MONTH ★

Mrs. E. M. Braddock, M.P., was guest of honour at DoRDeC's "Top Eight" Show at the Hungaria Restaurant, London, last month. Mrs. Braddock revealed that she is an ardent refrigerator user. Presiding was Mr. E. G. Rowledge, chairman of DoRDeC, supported by Mr. T. Whittaker, director, B.R.A.

Methane Pioneer, the converted tanker which brought to Britain the first load of liquid natural gas ever to be carried by sea, arriving at her Canvey Island terminal.

The Sea Carriage of Natural Gas

THE impact of refrigeration's services on industry in general is a fascinating subject and each month brings a crop of fresh applications. Some of these are fairly routine design jobs but others stand out on account of the possibilities which they bring in their train. Such a one in February caught the imagination of the world's press and of many industrialists. This new triumph for the low temperature specialists was the arrival in the Thames Estuary of *Methane Pioneer*, with the first load of liquid natural gas ever to be carried by sea.

Three or four more trial voyages of this nature will be undertaken before the technical and economic possibilities of this project can be fully assessed. Also, the load which has arrived has still to be transferred to the holder tanks at Canvey Island, reconverted to gas and taken by pipeline to the Romford Works of the North Thames Gas Board for reforming before it can be mixed into the town's supply. But already the arrival of *Methane Pioneer* has shown that it is technically possible for this gas to be trans-

The insulated pipeline which conveys methane from ship to shore gas-holders; insulation work was carried out by Onazote Insulation Co. Ltd.

ported over thousands of miles of ocean in liquid form at a temperature of minus 260° F.

Methane Pioneer left the Gulf of Mexico on her voyage across the Atlantic on Saturday, January 31. She is jointly owned by the Gas Council of Great Britain and Constock International Methane, Ltd., of the U.S.A. The experimental load consisted of 2,000 tons of liquid natural gas which came from one of the Gulf Coast oilfields. After liquefaction, which reduces its volume to 1/600th of the space occupied in gaseous form, it was loaded into five special tanks in *Methane Pioneer*. The tanks are aluminium with a 12 in. insulation of balsa wood and an outer jacket of steel. The liquid will be pumped from *Methane Pioneer* and through an insulated pipeline from the jetty to the two tanks which will receive the liquid. Each of the storage tanks has a capacity of about 1,000 tons of liquid natural gas. One has been built for the North Thames Gas Board by the Whessoe Company Ltd., of Darlington ; the other by the A.P.V. Company Ltd. of Crawley. The designs of the tanks were determined by the board in conjuction with the firms concerned.

Pumping Ashore

The liquid natural gas will be pumped from the cargo tanks on the vessel to the shore storage tanks by specially designed ships' pumps through a pipeline with a six-inch covering of insulation which was undertaken by the Onazote Insulation Co. Ltd. Although these shore storage tanks are heavily insulated there will be a continuous boil-off of gaseous methane from the liquid, and this material will be contained in a small gas-holder of the dry-sealed Wiggins type, whence it will be pumped into the mains system. Liquid methane will be vaporized by heat exchange with water or steam, and there is no intention at this stage of making use of the cold content or the refrigerating capacity of the methane. The liquid methane will be converted to gas under pressure, and this pressure will be used to convey the gaseous methane into the board's transmission lines. A new transmission line has been laid from Canvey Island to connect with a high pressure main already in existence between Shellhaven and Romford Works, and the gaseous methane will mix with refinery gases from the Shellhaven refinery.

The town's gas supplied by the North Thames Gas Board is distributed at 500 B.t.u. per c.ft., while the methane has a calorific value of 1,000 B.t.u. per c.ft., and reforming of the methane into gas of 500 B.t.u. per c.ft. will be carried out at Romford by the Onia-Gegi catalytic process.

The gas after reforming will have similar characteristics to gas normally produced from coal and will be suitable in every way for consumers' appliances, with the added advantage that it will be free from sulphur.

Natural gas in its original state is estimated to have an equivalent of approximately 530 therms per ton. Allowing for losses during the conversion processes and during the voyage it is estimated that the net value to the gas industry will be approximately 480 therms per ton. This means that the equivalent capacity of the trial shipment of 2,000 tons will be a little short of 1,000,000 therms. It will be appreciated that this trial load is a comparatively small quantity in relation to the demand for gas—the North Thames Gas Board, for instance, produces over 400,000,000 therms a year. If the trials prove successful, both from the technical and economic points of view, consideration will be given to the import of liquid methane on a much larger scale. Vessels carrying some 30,000 tons will probably be required in order to secure real economy.

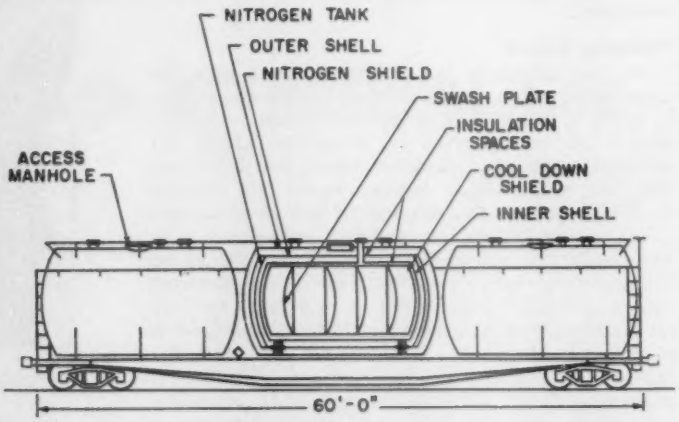
Onazote sections being applied to the pipeline.

We regret to record the passing of **Dr. Hans Sulzer,** at Winterthur, Switzerland. Dr. Sulzer, who was 82, had had a life-long association with his family's engineering business, Sulzer Brothers, Ltd., of Winterthur, of which he was the president; this business of course, included refrigeration plant manufacture. He was also the senior member of the board of directors of Sulzer Brothers (London), Ltd. In addition to his interests in the engineering field, Dr. Sulzer took a leading part in the industrial and economic life of Switzerland and was well-known internationally.

Transporting Helium over Long Distances in Liquid Form

THE Boulder (Colorado) Laboratories of the U.S. National Bureau of Standards has recently made a study for the U.S. Navy Bureau of Aeronautics on the feasibility of transporting helium over long distances in liquid form. Conducted by D. B. Mann and B. W. Birmingham of the Bureau's cryogenic engineering laboratory, the study reveals that large-scale liquefaction plants and liquid distribution systems compare favourably with compressed gas systems as a means of transportation when quantities and distances are sufficiently great.

The current importance of helium to both basic and applied research has focused attention on the cost of its transportation. For large users, such as the U.S. Navy, liquefaction and transportation of helium at or near its liquid density will lower gas costs by reducing shipping charges. This procedure will also facilitate distribution.



Insulated rail tank car, 13,000-gallon capacity, designed by the Cryogenic Engineering Laboratories of the U.S. National Bureau of Standards Boulder (Colorado) Laboratories for large-scale transportation of helium at or near its liquid density.

Helium gas is obtained from natural gas mixtures in the West Texas area, where it occurs in concentrations of up to eight per cent. At present, distribution of the extracted and purified gas from production plants to consumers requires the use of extremely heavy, high-pressure, cylinder tank cars having a limited gas capacity. Transportation costs are therefore an appreciable percentage of the total cost of the gas delivered to the consumer.

Both private and government research since the last world war have extended the number of uses for helium as well as increased the over-all demand. To-day consumption is 600 per cent greater than it was a decade ago. Until the war years, the primary application of helium was the lighter-than-air craft operations of the U.S. Navy. Although this use still represents a considerable percentage of the total helium consumption, other military and civilian users have been making larger and larger inroads into the supply of helium. U.S. Department of Defence requirements alone have outstripped liberal estimates. At present, rocketry, shielded arc welding, weather balloons for routine and research aerological activities, nuclear reactors, aeronautical research, and low temperature (cryogenic) investigations are the chief applications of this inert gas.

Liquefaction of helium, first accomplished by Onnes at the University of Leiden in 1908, is rapidly becoming a common cryogenic technique. Basically, the process of reaching low temperatures (close to absolute zero) is similar to that used in producing ordinary refrigerator temperatures. Compression of purified helium gas to a pressure of 220 lb. per in^2 yields about 10 per cent liquid when suitably precooled and expanded.

The solution which helium liquefaction offers for transportation difficulties led C.E.L. to undertake the design of suitable liquefaction facilities and transportable containers. This programme calls for location of the facilities close to a helium production plant for the greatest economy.

Process simplicity and ease of operation are of primary importance in planning the initial facility. The process recommended employs work-producing expansion engines, and requires the use of liquid nitrogen or liquid air as precoolants to produce the necessary refrigeration. In this way, precooling by liquid hydrogen with its accompanying hazards is eliminated and operational complexity is reduced. Another desirable result is greater cycle efficiency.

The operation suggested is a simple Claude-type cycle which consists of one expansion engine operating at a temperature below that of a liquid nitrogen

precoolant bath. A modification, made possible by a 155-atmosphere pressure differential, employs a second expansion engine in the helium-feed gas stream for the conservation of the liquid nitrogen refrigerant. The pressure of the helium feed from the production plant is 170 atmospheres while the operating pressure of the liquefier is only 15 atmospheres.

Pipe lines insulated and shielded with liquid nitrogen or liquid air make possible the efficient transfer of helium from the liquefier to transportable containers. The containers designed by C.E.L. are of a conventional liquid-nitrogen shielded, three-shell construction with evacuated powder as insulation. A new insulation, recently reported by private industry, has a thermal conductivity low enough to eliminate the need for liquid nitrogen shielding.

During transportation, isolation of the container allows the pressure to rise to some fixed design value based on travel time and rate of heat transfer, accomplishing " no-loss " storage. For example, newly designed tank cars call for an inner helium vessel capable of withstanding a 10-atmosphere pressure rise within a 10- to 15-day period. This is adequate for transportation within the continental United States. Stainless steel meets the requirements for the pressure vessel. Carbon steel or aluminium are the preferred metals for the outer ambient-temperature vessel.

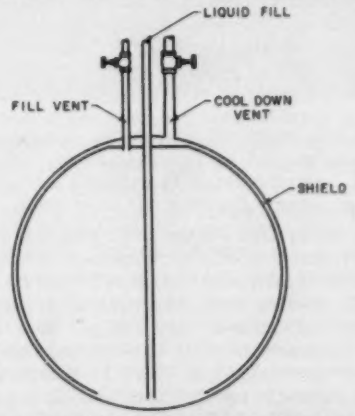
Upon arrival at a specific destination, helium must be transferred into compressed storage facilities; it cannot be kept indefinitely at low temperature without refrigeration. Two methods are proposed for this transfer: (1) If an adequate pressure is maintained in the container, helium can be forced through a heat exchanger, warmed to ambient temperature, and then piped to gas storage cylinders through conventional compression equipment; or (2) a low-temperature pump can be used to force the helium through a heat exchanger to compressed-gas storage.

The thermodynamic problems encountered in this proposed programme of helium liquefaction and transportation have received considerable attention. Two of these problems are: (1) Reducing the amount of liquid helium required to cool the storage vessel, and (2) eliminating temperature stratification of helium in the container.

The " cool-down " of equipment in which liquid helium is the only refrigerant is wasteful because of helium's low heat of vaporization. To reduce this waste, a well-known cryogenic technique was adopted so that a portion of the sensible heat of the cold helium gas that has been vaporized during the initial stages of the " cool-down " could be utilized. This was accomplished by incorporating a concentric shell inside the helium pressure vessel to channel the evaporated helium between the vessel and pressure shell. This design decreases the amount of liquid helium required for cooling by a factor of ten. An operational solution for the second problem is not, as yet, available. However, early results of an investigation currently underway provide a method of minimizing temperature stratification. It is thus possible to keep temperatures inside the vessel quite uniform so that pressure will not rise more rapidly than predicted. Being carried out concurrently with studies of liquefaction and storage is the design of transport containers of an optimum size with respect to minimum gross weight and maximum performance.

The specific design resulting from this study will fulfil U.S. Navy requirements for a liquefaction facility capable of condensing helium and delivering it to storage at a rate of 50 gallons per hour. The liquefied gas will be transported by insulated rail tank car having a capacity of approximately 13,000 gallons. The interest of other large consumers, stimulated by the economic and technical feasibility of the accepted design, has extended the studies to the design of liquefaction facilities with an hourly rate of 260 gallons. Truck-trailers with capacities to 6,000 gallons have been proposed for the transportation of less-than-carload quantities.

Small quantities of liquid helium are now also air-shipped in the United States. During the last six months, C.E.L. has shipped 12.5- and 19-gallon containers to a destination about 2,000 miles from the liquefaction source. Four to five shipments per month have been made by commercial air lines. The only special precaution necessary is a check valve on the normal vent line. This prevents air from being drawn into the liquid helium space by changes in atmospheric pressure. Losses during a typical shipment of this kind are less than one-quarter of a gallon.



Container designed by the Cryogenic Engineering Laboratory of the U.S. National Bureau of Standards Boulder (Colorado) Laboratories to decrease by a factor of ten the amount of helium (liquid) required in the "cool-down."

If large-scale helium liquefaction becomes a reality, many research programmes will benefit from a much lower cost of the liquid. This would reduce the cost of such studies as the development of liquid-helium-cooled, solid-state MASERS (Microwave Amplification by Stimulated Emission of Radiation) and cryotron computers. The MASERS are vital to scientific progress in radio astronomy and the cryotrons may make possible much more compact computers than are currently available.

More March News . . .

Better Foods Exhibition.—" The time is coming when refrigerators will be as important as cooking equipment," declared Professor Andrew B. Semple (medical officer of health, Liverpool) when he opened the Better Foods Through Refrigeration Exhibition at the Merseyside and North Wales Electricity Board industrial development centre, Liverpool, last month. Professor Semple said that Britain had the largest tonnage of refrigerated cargo ships in the world. Increasing quantities of processed foods were being imported in frozen form. There had been teething troubles but he had no doubt the difficulties, mainly due to inadequate precautions overseas, would be overcome. Refrigeration techniques were now so advanced that it was possible to store food until any time it was needed. Sooner or later the benefits of refrigeration for food storage would be fully appreciated by shopkeepers, caterers and housewives because it met the three fundamental requirements of hygiene—clean, cool and covered. On the subject of quick frozen foods, Professor Semple said that refrigeration and packaging had brought about a revolution in food handling. The tools of refrigeration and packaging must be used properly and it was the duty of the port medical officer to see that frozen products, particularly from overseas, were first class. The exhibition arranged by MANWEB in association with T. Beattie-Edwards and Co., L. Sterne and Co. Ltd. and Birds Eye Foods Ltd., covered the whole field of refrigeration with the emphasis on latest equipment for the display and storage of frozen foods. Beer and bottle cooling and milk cooling apparatus and models of refrigerated cargo ships were included. A buffet luncheon served at the opening was made up entirely of frozen foods. Mr. T. Beattie-Edwards, said that domestic refrigerators needed a big frozen food compartment and sufficient storage space for dairy produce. If a manufacturer produced a suitable model at the right price he would rent refrigerators to housewives for a few coppers a day.

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Longer-Term Grants for Researches.—Longer-term grants for special researches will be awarded by the Department of Scientific & Industrial Research in future. These grants—which have normally been limited to a maximum of five years—may now be awarded for an initial period of up to seven years with the possibility of continuing support for a further 10 years. This change in policy has been made to meet present-day needs. The more complex and expensive researches may require support for more than five years to become fully established. When fully established the support for these researches will be transferred from D.S.I.R. to the university ; arrangements are being worked out to simplify such transfer. The department is therefore willing to support for longer periods outstanding university investigators embarking on promising researches for which their universities are unable to make adequate provision. The main conditions are : An initial award for periods of three to seven years with the possibility of two renewals, each of a maximum duration of five years. A third renewal would not normally be given.

* * *

T. H. & J. Daniels Ltd. announce a mark II version of their 30/30 vacuum forming machine. This is a versatile general purpose, vacuum forming plant designed to produce vacuum formings using the drape method with plug assistance, and incorporating a bubble attachment by which the sheet may be pre-

stretched before forming. It is arranged for semi-automatic operation, the desired cycle being pre-set, the operator merely loading the sheet and removing the finished forming. The machine may be supplied as a self-contained unit, or the air compressor may be omitted if a suitable airline of 80 to 100 p.s.i. is available.

* * *

At the annual meeting of The Low Temperature Group of The Physical Society held in London recently, it was stated that during the year considerable progress was made towards the institution of a suitable memorial to the late Sir Francis Simon F.R.S., who, in addition to his many contributions to low temperature research, was the founder of the group. It has been decided to award, at intervals of approximately three years, a prize of £250 in cash to be known as the " Simon Memorial Prize," the prize man to deliver to the group a paper describing an aspect of the work for which the prize was awarded.

MODERN SPANISH COLD STORE

CONRESA—*The most efficient premises in Spain*

By Eduardo Möller, MECH.ENG., Barcelona*

VALENCIA—sun—fruit—are three words which are closely associated. This well-known Spanish Mediterranean town is mentioned among the world's most important fruit centres, and, therefore, a fourth word automatically fits in with the above association as a necessary link in fruit production: i.e., refrigeration.

The few and relatively old cold stores in Valencia could not by any means meet the requirements for cold and, therefore, the company Congelación y Refrigeración de Alimentos S. A.—"Conresa" decided to build an extensive and modern cold store of 883,000 to 1,060,000 c.ft., the first section of which of about 353,000 c.ft. is already in operation.

This cold store has attracted much attention in refrigeration circles on account of the amount of thought that has gone into its design.

Excellent loading bank facilities at Conresa.

The technical advice and the supply and erection of the plant were entrusted to Sabroe's licensee in Spain, Hans T. Möller, S.A., Barcelona. The compressors were built at Sabroe's works in Aarhus, while the remainder of the plant was made in Barcelona under Sabroe's licence.

This first portion of the cold store consists of two floors, each with six equal sized cooling rooms.

The project calculations were based on the desire for a generally useful all-round store, which, besides fruit, should also be able to accommodate other sorts of commodities. Four of the rooms, therefore, have been designed for operation either at 32° F. or at −4° to −13° F.

On the second floor there is a 5-ton quick-freezing tunnel for freezing at −40° F.

When designing the plant particular stress was laid on a rational division of rooms, ante-rooms and reception platforms with a view to the reduction of working expenses. For the same reason the "curtain walls" insulation method was chosen.

The third condition for obtaining simple and economic working of the plant was a reliable pipe arrangement and an intensive centralization of the machinery.

The result has been much better than was expected because this big cold store can easily be attended to by one engineer, and a minimum of labour only is necessary for the charging and discharging work.

Also, the insulation has stood up to its test. During the extensive flooding in Valencia the cold store

* By courtesy of *Sabroe News*, Aarhus.

Typical air-cooled chamber.

was without electricity for 66 hours; nevertheless the temperatures in the rooms rose only between 2° and 3.5° F.

Conventional cold stores are normally designed with one central corridor with cooling rooms on both sides. This division, however, has several inconveniences: the coldest wall surfaces border on the outside air; only two, or at most three, entrance doors are available and with long distances from the doors to the distant cooling rooms; the corridor will often prove to be too small for the internal traffic of goods and the platforms will also be too small so that the motor-lorries have to wait to be loaded or unloaded; valves and controls for the cooling coils and fans are generally placed in the corridor and may be exposed to unauthorized handling.

When designing the plant in Conresa, orthodox designs were completely set aside, and the divisions made strictly to meet the purposes intended.

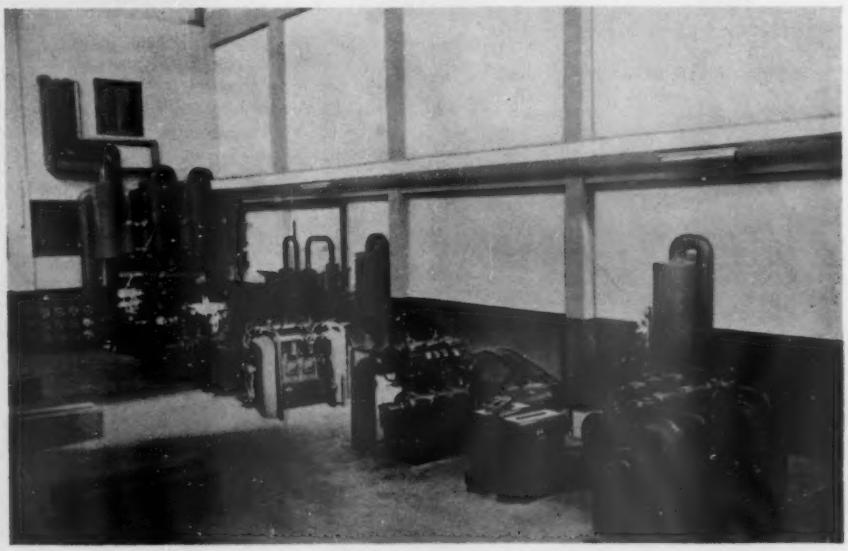
All the cooling coils were placed in a little central corridor which contains the valve controls for the various cooling rooms.

This corridor is only accessible to the engine room staff.

The cooling rooms are placed on each side of the corridor and all around are the ante-rooms with entrances to the cooling rooms. The reception platforms are placed at both ends of the building, and this renders possible the simultaneous loading and unloading of the motor-lorries which stand in close to the rooms being worked.

In this way is obtained the ideal thermal division with the coldest places in the central corridor (which forms the backbone of the cold store) and with the warmest places in the periphery of the building.

The central part, with the cooling rooms and coils, forms one block and is separately insulated with " curtain walls."



The cleanly laid out engine room.

The circumferential ring formed by the ante-rooms is completely independent both from a building and from an insulation point of view.

This form of construction allows the insulation to be made under cover after the building has been finished. This is often not possible in cold stores undergoing insulation.

The Machinery Installation

What is attracting the greatest attention to Conresa's cold store is the intensive centralization of the whole refrigerating machinery. In this first building the engine room is situated at one end of the store, but, when the extensions have been finished, it will be at the centre.

From the engine room the pipes lead into a cellar, and from there through a cellar-corridor under the central attendance corridor on the upper floors. In this way all the horizontal main pipes are contained in the cellar-corridor from where branches lead directly up to the various cooling rooms.

This design provides a considerable saving of piping and requires a less vigilant attendance on the plant.

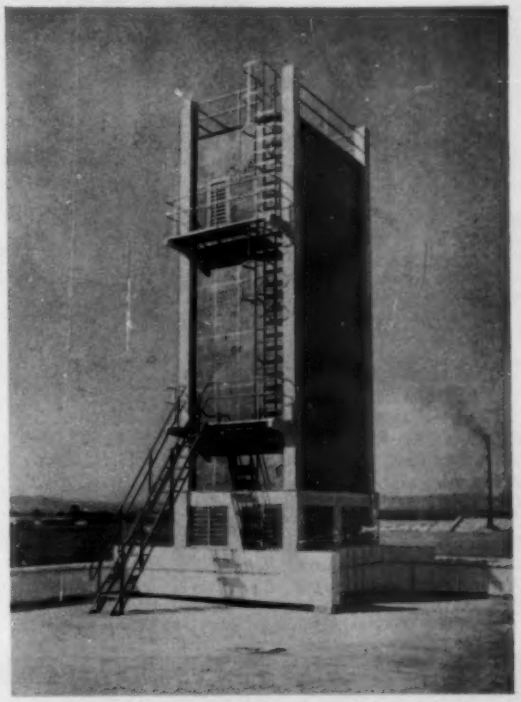
In this particular building, the machinery comprises four Sabroe compressors type TSA 48 and space has been left for a further four compressors in the future. All these machines can operate in one or two stages.

The cooling units are float regulated, and a future fully automatic working has been anticipated by installing magnetic valves and thermostats.

The air-coolers have been made with plain fins, while three of the rooms have been provided with wall coils for the storing of frozen goods. The fourth room was experimentally provided with an air-cooler with plain fins and the result has proved so satisfactory that all future minus rooms will be provided with air-coolers of the same kind.

The degree of humidity may be kept as high as with wall coils and it is easier to obtain a constant temperature over the whole room.

The connecting pipes in the plant have been provided with blind flanges and valves in the right places so that the extension may be carried out without any interruption.



Contemporary treatment of the water cooling tower.

Conresa's new cold store has been designed and built in strict accordance with the technical advisers' instructions; the result has been a beautifully functioning cold store which is being described as exemplary.

A new plastics factory to make equipment for the electrical, motor car, radio, photographic and allied industries came into scale operation on February 1 at Reading. It is being operated by **Resinoid and Mica Products Ltd.** which was formerly a subsidiary of Southern Areas Electricity Corporation Ltd. R.M.P. has recently been acquired by Mr. Joseph R. Severn who becomes managing director. Mr. Severn has taken over key personnel from the Birmingham plant which will be gradually closed down as the new plant comes into full operation. Continuous service will be given to customers. Both thermoplastic and thermosetting intermediate products will be made. Existing injection presses have been taken over but new compression presses have been installed. The new plant has been sited to give easy access to South Wales and the West, the South of England, the Midlands and West London.

* * *

Pliofilm, the transparent packaging film developed by **The Goodyear Tyre & Rubber Co.**, recently celebrated its 10th anniversary as a British manufactured product. Since production of this rubber hydrochloride film began at the Wolverhampton plant in 1949 it is estimated to go round the world one and a half times. Pliofilm, made in a range of grades to suit many applications, is noted primarily as an ideal agent for the packaging of fresh meat, poultry, cheese and many other non-food goods. Two of its toughest tests, however, were its use by the Everest Expedition in 1953 and the Trans-Antarctic Expedition in 1957.

DOMESTIC REFRIGERATION DEVELOPMENTS

THE ENGLISH ELECTRIC APPLIANCE FACTORY

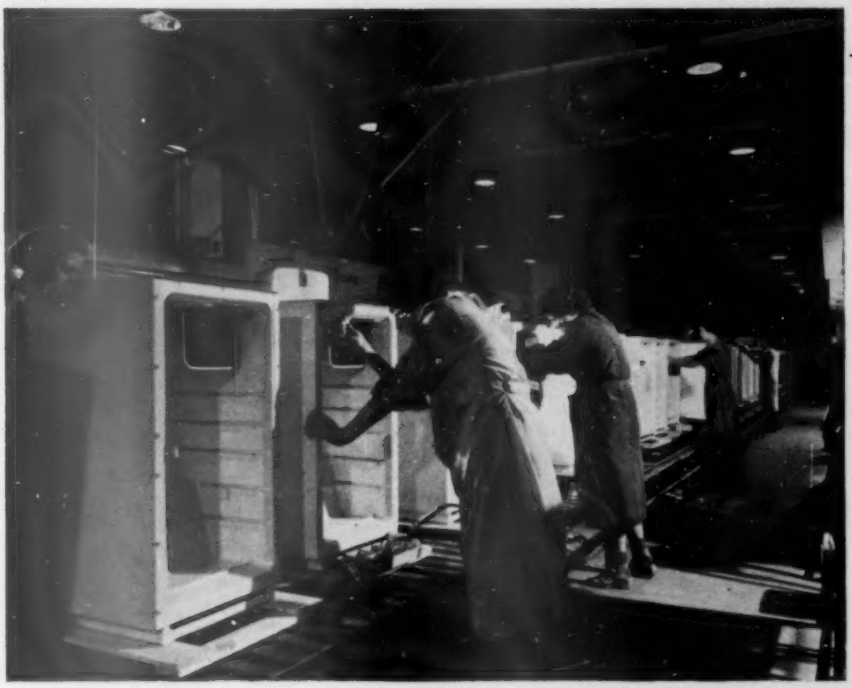
The technical Press were last month shown for the first time the latest manufacturing techniques used in the domestic appliance factory of The English Electric Co. Ltd. at East Lancashire Road, Liverpool. The journals honoured with a visit were *Electrical Review*, *Electrical Times*, *Electrical Journal*, *Electrical Export Industries*, *Electrical and Radio Marketing*, *British Engineering International* and *Modern Refrigeration and Air Control*.

The party was received by Mr. H. C. Timewell, chief of the appliance division, who needs no introduction to the industry.

At these premises outside Liverpool over 300,000 sq. ft. of manufacturing area are devoted to the production of refrigerators, electric cookers, radiant plates, washing machines, tumbler dryers, food mixers, plate warmers and fractional horse-power motors for washing machine application. The equipment and techniques employed are of the very latest design and additional facilities are being installed to meet the ever-increasing demand for the division's products.

An outstanding feature of this plant is the emphasis that is placed on overhead conveyerization of the

On the production line, the English Electric Slimline refrigerator being fitted with evaporator assembly and hermetically sealed unit.



On the assembly line the English Electric Slimline refrigerator being fitted with an aluminium evaporator finished in durable lacquer.

Another view of the 3.6 c.ft. refrigerator on the production line.

Refrigerator units for the Slimline model undergoing performance tests in the high temperature test chamber.

products. In the early stages of manufacture of the various component parts, no segregation of the individual items on these lines takes place, shells and doors of refrigerators and ovens proceeding cheek by jowl through the paint plant on the Fisher and Ludlow mechanized lines, thereby providing a highly concentrated and efficient throughput at all seasons of the year. These conveyers carry pressings to the processing shops and, as fully finished parts, these pressings are eventually fed into the assembly lines.

In the press shop there is a battery of power presses of various sizes including 400-ton presses for large and heavy pressings, and shortly presses of up to 800 tons will be installed.

Two of the latest type continuous vitreous enamel furnaces are working seven days a week to turn out all the vitreous-enamelled parts for refrigerators, cookers and washing machines. The synthetic enamel shop is of unique design as the drying tunnels are built in the eaves of the roof to save factory space and to give a greater utilization of shop floor area. Before entering the enamelling tunnels, the metal fabrications are subjected to intense degreasing and finishing in an industrial washing machine by Curran's of Cardiff; this carries out the following processes: degrease, rinse, acid treatment, two rinses, nickel treatment, rinse and drying in a neutralizer.

Welding equipment is varied and comprehensive and there are extensive machining facilities. Large Sciaky seam welders make light work of joining the casings of the spin dryers.

The refrigerator processing plant includes a fully automatic vacuum pumping and charging plant where a refrigerator compressor is charged with oil and refrigerant in less than 60 seconds. Attached to this plant are the performance test rooms where hundreds of complete refrigerating units are carried by conveyer in a temperature and humidity-controlled room before entering an isolated compartment for noise level tests. This room is maintained at 78° F. and 45 per cent. R.H. Herein each unit is given a low-volts starting test, a consumption test and a flash test. It is interesting to record that English Electric are discontinuing the manufacture of their sealed units and are fitting Sternette's Tecumseh hermetics.

Great emphasis is placed throughout the manufacturing process on quality control. There are laboratories for the control of enamelling frits and separate laboratories for metallurgy and chemical analyses. There are hot rooms where refrigerators and finishes may be tested over a wide range of temperatures and humidities, with particular reference to unusual conditions obtaining in overseas markets.

Within these works are shops for producing both heavy and light die-cast parts as well as plating shops. Many of the plastic parts used in the manufacture of appliances are made in the company's plastic division at its Bradford Works. Bradford also supply castings from their mechanized foundry.

All the assembly lines feed into the packing and despatch area where the appliances are carton-packed and loaded on company vehicles for delivery to all parts of the United Kingdom. The fact that the works are in the Liverpool area is of considerable assistance in giving quick delivery on export orders because most of the docks are within 10 miles of the appliance works.

Liverpool is also the headquarters of the division's service department. Here many thousands of spare parts for a full range of products, including those made 20 years ago, are kept for "off-the-shelf" delivery. It is also the administrative centre for the division's field service consisting of service stations situated in key

centres throughout the country and with facilities for training field personnel working with the company or attached to dealers' staffs. They maintain trained men, each with a van, at the following points : London (21 servicemen) ; Bristol (13) Cardiff (2) ; Birmingham, including Leicester, Nottingham and Stoke (8) ; Liverpool (9) ; Manchester (5) ; Leeds and Sheffield (5 each) ; Newcastle (3).

The division's other activities at Liverpool include appliance engineering and design, development laboratories, model shops, a home economics laboratory for practical testing of prototypes and production models, jig and tool design, extensive drawing offices, and a market research and statistics unit.

English Electric executives photographed by "M.R." With Mr. H. C. Timewell, appliance division chief, third from right, are, l. to r.: Mr. S. M. Boyce, Mr. T. Davidson, Mr. C. E. Heap, Mr. A. M. Parkinson, Mrs. M. Herz, Mr. H. Watson and Mr. K. Miller.

MORE 1959 FRIGIDAIRE REFRIGERATORS

THE keynotes of Frigidaire's new 1959 range of household refrigerators, are quality, colour and economy. The remaining five models in the range were announced last month. Quality is underlined by the additional features incorporated in this year's models and by the streamlined 1959 styling.

Colour in the interiors has taken on a new, cool look, with contrasting white, light blue and pearlescent dark green. Price of the 3·3 c.ft. model remains the same as last year. Prices for the larger refrigerators, 8·4 and 10·1 c.ft. respectively, have been reduced.

MZ–33T Master Model 3·3 c.ft. (Gross)

Only 21 in. sq. and 36 in. high the MZ–33 has more shelf area, increased capacity and more new design features than ever before. It incorporates the Frigidaire 1959 colour-cool interior finish, special action safety handle and new-type door gasket which ensures that heat leak is reduced to a minimum. Available in four model variations, free standing or for building in (MZ–33A), and with left or right hand door, the model is obtainable in all five Frigidaire colours — Snowy white, Cotswold cream, Sherwood green, Olympic red and Mayfair pink. There are beige table tops for the pink models, cream for the red models and matching tops for the remainder.

Inside the door are three shelves for the storage of eggs and bottles, while the most awkward items can easily be placed on any of the three fully adjustable and interchangeable interior shelves. Door store shelf fronts are removable to make cleaning easier. Overall shelf space is now increased by over 25 per cent. to 6·7 sq. ft. and the freezer compartment takes up to 7 lb. of frozen food.

With more capacity than ever before and increased shelf space, the MZ–33T has been built to give maximum storage space while occupying minimum floor space—the best answer refrigeration can give to the problem of storing food properly in a small kitchen.

Price : (Including purchase tax) £59 17s.
(For building in MZ–33A: £58 16s.)

MZ–84 Master Model 8·4 c.ft. (Gross)

The MZ–84 with five fully adjustable interior shelves, full width hydrator and four shelves and a butter compartment in the door store provides a total shelf area of 15·8 sq. ft. Frozen food capacity

in the super freezer is 19½ lb., and the door store shelves have been so designed that they accommodate bottles of the most awkward lengths, including a hock bottle. A feature of the door store finish is the fluted moulding on the lower bottle shelf designed to hold bottles securely. These door store shelf fronts in the dark pearlescent contrast colour are removable for easy cleaning.

With an entirely new design inside and out, interior colours are in the 1959 Frigidaire colour-cool contrast. The MZ–84 is available in all five Frigidaire colours.

Price : (Including purchase tax) £122 17s.

DZ–84 De Luxe Model 8·4 c. ft. (Gross)

Even more frozen food can now be stored in the new style super freezer chest incorporated in the DZ–84. This full width low temperature freezer will now accommodate 46½ lb. of frozen food for periods of up to six months, provided the food is stored before it has begun to thaw. Small quantities of home grown produce can be frozen and stored for a similar period.

Four fully adjustable and interchangeable shelves, and a full width hydrator, together with a comprehensive door store similar to that in the MZ–84, are additional features which together provide 16 sq. ft. of shelf area. The DZ–84 with the colour-cool interior is sold in a choice of colour embracing the five Frigidaire exterior colours.

Price : (Including purchase tax) £135 9s.

MZ–101 Master Model 10·1 c. ft. (Gross)

The MZ–101 has a total of six interior shelves as well as a full width hydrator and possesses what must be one of the most comprehensive door stores ever built into a domestic refrigerator. Two bottle shelves and two egg racks have removable shelf fronts ; one of the bottle shelves has a fluted background for bottle security, and even the tallest bottles can be accommodated. In addition there are cheese and butter compartments which together with the shelf fronts are finished in the new pearlescent dark green contrast colour. The super freezer which has a vitreous enamelled door in pale blue

The new Frigidaire 3.3 c.ft. refrigerator, model MZ-33, is available for building in and with left- or right-hand door. Measuring only 21″ wide by 21″ deep, the MZ-33 has a total shelf area of 6.7 sq. ft. and this combines maximum storage space with minimum floor area.

De Luxe Frigidaire 10.1 c.ft., DZ-101.

holds 27 lb. of frozen food, and the total shelf area is no less than 19·1 sq. ft. The MZ–101 is available in all five Frigidaire colours.

Price : (Including purchase tax) £156 9s.

DZ–101 De Luxe Model 10·1 c. ft. (Gross)

The latest in refrigerator luxury, the DZ–101, combines increased shelf space of 18·3 sq. ft. with increased frozen food capacity in the insulated super freezer chest of 46½ lb., to give maximum planned storage space. As with the DZ–84 small quantities of home grown produce may be frozen. In the refrigerator itself there are five fully adjustable, plastic covered, anodised trimmed shelves ; in the door, butter and cheese compartments, two egg racks and two shelves for bottles—these are just a few of the many features. As with all the new Frigidaires, the streamlined interior and the 1959 colour-cool interiors add that finished touch of quiet richness. The DZ–101 is available in any of the five Frigidaire colours.

Price : (Including purchase tax) £171 3s.

The exclusive Frigidaire " Meter-Miser " rotary compressor powers all Frigidaire models. It is warranted for five years. The refrigerant used is R.12. (dichlorodifluoromethane).

MAIN FEATURES OF FRIGIDAIRE 1959 HOUSEHOLD REFRIGERATORS

Features	MZ–33T without table-top MZ–33A	MZ–45T without table-top MZ–45A	DZ–45T without table-top DZ–45A	MZ–84	MZ–101	DZ–84	DZ–101
Capacity c.ft gross	3·3	4·4	4·4	8·4	10·1	8·4	10·1
Capacity c.ft. nett	3·2	4·3	4·3	8·1	9·7	7·7	9·4
Shelf area sq. ft.	6·7	8·9	8·9	15·8	19·1	16·0	18·3
Shelves	3	3	3	5	6	4	5
Super freezer vertical or chest ...	V	V	V	V	V	C	C
Frozen food storage, lb.	7	10	10	19½	27	46½	46½
Interior light	No	No	Yes	Yes	Yes	Yes	Yes
Hydrator	No	No	Yes	Yes	Yes	Yes	Yes
Door shelves	2	2	2	2	2	2	2
Egg rack	1	1	1	2	2	2	2
Butter compartment (in door) ...	No	No	Yes	Yes	Yes	Yes	Yes
Cheese compartment	No	No	No	No	Yes	No	Yes
Exterior colour availability* ...	Yes all†	C & W only	Yes all	Yes all	Yes all	Yes all	Yes all
Door hinged on left or right ...	L or R	L or R	L or R	R	R	R	R
Height in.	36	36	36	54½	62½	54½	62½
Height in. (without table-top) ...	35	35	35	—	—	—	—
Width in. (overall)	21 1/16	24½	24½	27½	27½	27½	27½
Depth exc. hardware in.	21¼	24⅜	24⅜	27¼	27¼	27¼	27¼
Meter-Miser sealed unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Table-top porcelain on steel ...	Yes	Yes	Yes	No	No	No	No

*Colours :— Mayfair Pink
Sherwood Green
Snowy White
Cotswold Cream
Olympic Red

Table Top Colours :— Cream with Red Cabinet
Beige with Pink Cabinet
All Others Matching

†The MZ–33A will only be available for " building-in " in Cream or White.

ASTRAL CONSOLE

Once again, Morphy-Richards have introduced an improved version of one of their popular products without increasing the price. This time, it is a new "Console" refrigerator in their "Astral" range. This 2.3 c.ft. refrigerator now has a larger evaporator-unit containing three ice-trays, making 1.6 lb. of cubes (36 cubes), and will store up to 11 lb. of frozen foods. Recommended for average size families, the new "Console" has 4.7 sq. ft. of shelving area. Each of its wire shelves can be arranged in any of three different positions. Special features are the two door shelves, which hold butter, milk, cheese and cream—dairy produce that retains its flavour best if not overchilled, while butter can be kept firm but not hard. There is a drip-tray that can be used as a lid for the chiller which is also provided. The M-R "Astral" Console has a silent absorption unit, thermostatically controlled and is suppressed against radio and television interference. 't operates by electricity, or gas, or bottled gas. The electric model has a loading of 120 watts, on AC/DC mains, in three voltage ranges: 110/115, 190/220, and 220/250. Available in either white or cream, the external dimensions remain the same at 36 in. high, 22 in. broad and 21¼ in. deep. The electric and town gas models retail at £46 4s. (net list £37 15s., plus P.T. £8 9s.), with the bottled gas model retailing at £50 13s. 7d. (net list £41 8s. 3d., plus P.T. £9 5s. 4d.).

DOMESTIC REFRIGERATION

Electrolux's Showroom Refurbished

Electrolux Limited has completely redesigned and modernized its showroom at 153/5 Regent Street, London, W.1. This is a view of the refrigerator section, and at the rear built-in models are displayed in kitchen arrangements. Laundry equipment occupies a section at the right. Electrolux cleaners and floor polishes are demonstrated at the front of the L-shaped showroom. Electrolux's own Display Department was responsible for the design and supervised the execution by Phoenix Artists Ltd., 24/25 Cowcross Street, London, E.C.1.

THE SHAPE OF THINGS TO COME ?

Westinghouse (U.S.A.) have lately produced this dining room/kitchen "divider" type refrigerator.

The Ace Pump Corporation, of Memphis, Tennessee, has sent us details of their Ace model 77 diaphragm descaling acid pump. The model 77 diaphragm pump has been specifically designed to handle the very difficult application of pumping acids and other solutions used to descale clogged condenser coils. All materials in the pumping chamber of this pump are acid resistant and there are no seals or packing glands to leak. There is no gradual loss of capacity due to wear of the pump and it can be maintained in the field.

ELDWOOD CABINETS

L. D. Wood (Eldwood) Ltd. are now producing a completely new range of glass-fronted, frozen food cabinets. These cabinets are called the "Pinner," "Harrow" and "Northwood," and the net capacity of these machines are 9·5 c.ft., 12·8 c.ft. and 15·6 c.ft. respectively. The new models are, in appearance, similar to the Eldwood F.137 and F.202 frozen food cabinets, which have proved to be so popular with all sellers of frozen food. As these machines can be fitted with either plastic canopy, mirror-backed canopy, glass risers or supplied without superstructure, and as all fittings are universal, one model can easily be altered to another, to suit customers' requirements. The retail prices of the new cabinets complete with units range from £191, plus installation charges, for the "Pinner" without superstructure, to £262, plus installation charges, for the "Northwood" with plastic superstructure.

In addition to the above cabinets, Eldwood have now consolidated their range of County class frozen food cabinets which incorporates Middlesex, Devon, Kent, Anglesey, Durham 4 and Durham 6 machines. Here again, superstructures are interchangeable. The advantage of this change-over can be seen when the customer has had a County class frozen food cabinet, then at a later date decides to purchase a "Pinner" glass-fronted frozen food cabinet. The superstructure can be removed and fitted to the "Pinner," and a set of lids obtained from the manufacturers for the old model, which can then be used for storage purposes in the rear of the shop or in an outhouse. For the larger shops, where more space is available, Eldwood are producing a 16-c.ft. frozen food cabinet known as the "Suite 16" which is ideal for an island site, but can also be used for incorporating into a counter, or wall display. This model, at approximately £220 retail, is thought to be the most economically priced machine on the market. This machine, too, can be supplied with various superstructures or glass risers. To complete the range of packaged equipment suitable for all food trades, Eldwood have incorporated into their range a high-temperature display counter known as the "Wembley," size 71¾ in. by 29¾ in. by 40¼ in., a "Little Giant" portable display case, size 42 in. by 24 in. by 36 in., which is most suitable for fast selling of such things as butter, margarine, ham, bacon, chilled bottle drinks and bakers' confectionery, and a counter top, or window display case, named the "Enterprise" which, although measuring only 71¾ in. by 32 in. by 14¼ in. high, has a shelf area of 68 in. by 20¼ in.

Levin Cabinets in Britain. Aktiebolaget K. J. Levin, of Malmö, Sweden, recently held a two-day distributors' conference in London, when the newly-appointed Levin distributors for England, Wales, Scotland and N. Ireland, covering the entire country, convened for the first time. In all, 19 firms, of which 15 were present during the conference, were represented by one lady and 21 gentlemen. The conference took place at the Washington Hotel on February 9 and 10. Among other matters the following points were discussed and finally decided: Distribution areas, U.K. retail prices, delivery and installation fees, arrangements regarding national accounts, inter-territorial arrangements, shipping, packing and service questions, literature, advertising campaigns, exhibitions, stockholding plans, etc.

Lunch the first day was had at the Washington Hotel, dinner on Monday night at the Monico Restaurant, Piccadilly Circus, and luncheon the second day at the Dickins & Jones in Regent Street, where Danish smörgsbord was put on.

The entire proceedings were presided over most efficiently and amiably by Mr. H. Henriz, sales director from Malmö.

Levin's have decided to participate, together with their London distributor, Bland Bros., in a small stand in the Self-service Exhibition at the Olympia on May 11 to 15.

The distributors are as follows (with the names of those attending the conference): Bland Bros. (Electrical) Ltd., Foregate House, Shrewsbury (Gerald C. Bland, Managing director); Bland Bros. (Electrical) Ltd., Hudson Motors Building, Great West Road, Chiswick, London, W.4 (M. E. Corfe, general manager); L. Block & Co., 1, Middle Pavement, Nottingham (Leo Block, managing director); Refrigeration Cornwall Ltd., 23, Tre-

(*continued on page 257*)

The assembled company at the Monico Restaurant.

TENTH CONGRESS

EXCURSIONS

AMONG the educational and scenic excursions arranged for participants in the 10th Congress in Copenhagen during the period following the termination of official business are :—

I Copenhagen and Surroundings

The excursion lasts two whole days, *i.e.* Thursday, August 27, from 8 a.m. till about 6 p.m. Friday, August 28, from 8 a.m. till 6 p.m. It comprises technical visits to a cold store, an urban dairy, a factory for manufacture of refrigerators (A/S Atlas), a supermarket, a meat canning factory, a dry ice factory, a crystal ice factory, and a brewery. The programme includes lunch both days, however, not breakfast, dinner, and hotel accommodation.

II Zeeland

The excursion lasts two whole days, *i.e.* Thursday, August 27 and Friday, August 28, each day starting from Copenhagen at 8 a.m. and returning to Copenhagen between 7 and 8 p.m. The excursion comprises technical visits to a factory for refrigerators (A/S Atlas), a research institute (meat and bacon), a poultry slaughterhouse, a cheese factory, a mink farm, a chemical factory, a bacon factory, a factory for air-conditioning material, and a cold store. The programme includes transport by coach. En route places of historical and tourist interest will be passed.

III South Jutland

The excursion starts from Copenhagen on Wednesday August 26, in the afternoon and ends in Copenhagen on Saturday August 29 at about 11 p.m. The excursion comprises technical visits to bacon factories, cold stores, a brewery, a factory for refrigerating machinery (A/S Brd. Gram, Vojens), a factory for automatic equipment (Danfoss, Nordborg), a poultry slaughterhouse, a fish freezing plant, a co-operative dairy and a clear ice factory. In case a large number of ladies, who are not interested in technical visits, participate in the excursion, small excursions by coach to places of tourist interest will be arranged for these ladies during certain technical visits.

IV North Jutland

The excursion starts from Copenhagen on Wednesday August 26, at about 11 p.m. and ends in Copenhagen on Sunday, August 30, at about 7 a.m. The excursion comprises technical visits to a bacon factory, a cold store, a butter factory, a factory for refrigerating machinery (A/S Sabroe, Aarhus), a meat canning factory, a poultry slaughterhouse, a fish freezing plant, an urban dairy, and an ice factory.

A programme of visits for associates during the first week of the Congress has been arranged. Full information will be available later. However, already at this stage the two-full-day excursions described below are announced, as the number of participants will be limited. Therefore, if readers wish to participate in one or both of these full-day trips, in their own interest they should mark off their wishes on the enclosed form, sign it, and mail it to the congress secretariat.

I Full-day trip on Thursday, August 20

Departure : 9.45 a.m. from Congress Building. By coach along the Sound by the coastal road, often called " The Danish Riviera," with beach resorts, fishing hamlets, and beautiful mansions.

At Humlebaek visit to " Louisiana," museum for contemporary art, situated in a lovely park facing the Sound.

Lunch at " Kystens Perle " (" The Pearl of the Coast "). Sight-seeing trip continues overland with stop among others at the " Fredensborg Castle," one of the summer residences of the Royal Family.

Visit to " Frilandsmuseet " (" The Open-Air Museum "), a collection of old Danish farm houses and such, typical of the parts of the country from where they have been transferred.

Arrival at Congress Building at about 5 p.m.

II Full-day trip on Monday, August 24

Departure : 9.45 a.m. from Congress Building. Sight-seeing by coach in the environs of Copenhagen. Visit to " Danmarks Akvarium," one of the best of Europe. At Klampenborg change from coach to horse-drawn carriages for round-trip of " Dyrehaven " (a vast recreation park), where the " Eremitagen Castle " is situated, a tiny architectural beauty, formerly used by Danish kings for hunting parties.

Lunch at " Bellevue " on the Sound, followed by a fashion show. Trip arrangements end here. Electric suburban train (" S-train ") leaves at 20 min. intervals from nearby Klampenborg station to Copenhagen (15 min. to city centre).

* * *

We learn from the headquarters of the Congress that applications for membership are coming in quite rapidly.

It may interest those who have not yet signed on that after April 1, the registration fee of D.Cr. 60, will be increased to D.Cr. 80, and after July 15—as a " last-moment-fee "—it will amount to D.Cr. 120. Beside the registration fee the following fees are payable : Donor members D.Cr. 740 ;

full members D.Cr. 240 ; associate members D.Cr. 140.

At the sessional meetings many interesting lectures will be heard. Lectures have been notified in commissions 1, 2, 3, 4, 5, 6, 7 and 8 from Russian participants—26 in all and in addition, 2 for the plenary session.

The lectures vary from " Experience in operating mechanically refrigerated railway trains in the U.S.S.R." to " The method of thermodynamic analysis of low temperature rectification of binary mixtures."

Incidentally, the chairman of the papers committee points out that although the time-limit for delivery of lectures has been exceeded, the committee asks anybody at present completing lectures to submit these after all, as the committee is prepared to accept these papers.

CONGRESS PROVISIONAL ARRANGEMENTS

Day	Morning	Afternoon	Evening
Tuesday, August 18		2.0 Technical Board (B) 3.0–8.0 Registration	
Wednesday, August 19	8.0–10.0 Registration 10.0–12.0 Opening Ceremony (City Hall)	2.0–5.30 Commission meetings	Social occasions*
Thursday, August 20	7.30–9.0 Technical visits 9.0–12.0 First Plenary Meeting	2.0–5.30 Commission Meetings	Social occasions
Friday, August 21	9.0–1.20 Second Plenary Meeting (12.0–2.0 Arrangement)	2.0–6.0 Technical visits	8.0 Evening lecture
Saturday, August 23	9.0–12.30 Commission Meetings	3.0 General Conference (B)	Social occasions
Sunday, August 23	(Sight-seeing arrangements)		
Monday, August 24	9.0–12.0 Third Plenary Meeting	2.0–5.30 Commission Meetings	Social occasions
Tuesday, August 25	8.0–12.0 Technical visits 9.0 Executive Committee (B)	2.0–5.30 Commission Meetings	Social occasions
Wednesday, August 26	9.0–12.0 Commission Meetings 12.0–1.30 Closing Ceremony	Technical country excursions	
Thursday, August 27 till Wednesday, September 2	Technical Copenhagen excursion Technical country excursions		

*Civic receptions, banquets, and similar social occasions.
" (B) " means closed business meeting of the I.I.R.
Associates' programme is not shown above.

OBITUARY

We regret to record that Mr. J. Brook, A.M.I.P.E., works director of Dewhurst & Partner Ltd., died at his home last month aged 60. Mr. Brook began his career with Marryat & Place Ltd. and served during the 1914–18 war in the Royal Marines. He was well known in the electrical control equipment industry and played a large part in the development of new production techniques. He was particularly interested in apprenticeship training schemes and in the early 1920s inaugurated the Dewhurst scheme which has since been used as a model by other companies in the area.

"MANAGEMENT FOR SALES"

Sales are the end product of any business and the concern of the whole company from messenger to managing director. **"Management for sales"** has been chosen, therefore, as the general theme of the northern conference of the British Institute of Management to be held at the Prince of Wales Hotel, Southport, on April 2 and 3. The delegates—the managers of the north—will meet to consider the sales function in the broadest sense under present conditions, and the conference will provide meetings with leading speakers and discussions of interest both to general and specialized management.

The Largest Injection Moulding Machine Built

EKCO INSTALL THE WINDSOR AP. 335

"MR" had the opportunity to inspect last month the largest injection moulding machine built in the United Kingdom; this was recently installed in the Southend works of EKCO Plastics Ltd. Designed and built by R. H. Windsor Ltd., one of the world leaders in the manufacture of machinery for the plastics industry, this 73-ton giant, the AP. 335, is now in full operation producing top grade, stress-free mouldings of large dimensions.

Currently being moulded on the AP. 335 at the EKCO works are complete refrigerator liners of three and one-third c.ft. capacity for Frigidaire, made in B.X. polystyrene with a shot weight of 104 oz. and measuring overall 26¾ in. × 19⅜ in. × 14 in.

Fitted with the famous Autoplas pre-plasticizing unit, this machine has a plasticizing capacity of 420 lb. of polystyrene per hour calculated on the continuous rating of the pre-plasticizer. The swept volume of the injection stroke is 335 cubic inches (5440 cm.³) of plastic material or approximately 210 oz. (5953 gr.) of polystyrene.

Although this is the first machine of such large capacity to be put into commission in Great Britain, similar Windsor machines have been in continuous use on the Continent for some time. Thus, a great deal of valuable information has been obtained on the high-speed production of large, stress-free mouldings.

Full details of this latest addition to the already world famous range of injection moulding machines by R. H. Windsor Ltd. are as follows :—

Specification of AP. 335 Machine

*Capacity...	The swept volume of the injection stroke is 335 c. in. (5480 cm.³) of plasticized material = approx. 210 oz. (5953 gr.) polystyrene.

The largest injection moulding press in the country has been installed in a new extension to the Ekco Plastics injection moulding plant at Southend-on-Sea. The first task of this new machine, which can produce thermoplastic mouldings weighing up to 12 lb., is the production of the complete inner lining for a new Frigidaire refrigerator—the first refrigerator to incorporate an injection-moulded inner lining.

‡Plasticizing capacity per hour	420 lb. of polystyrene.
Diameter of injection plunger	5 in.
Area of injection plunger	19·635 sq. in.
Total load on injection plunger	245,440 lb.
Pressure on plasticized material	12,500 p.s.i.

At the press reception given at the Ekco Works, Southend-on-Sea, last month, Mr. David Radford, director and general manager of Ekco Plastics Ltd. (right), discusses the largest injection moulding machine in the country with Mr. R. Poole, technical manager of the Frigidaire Division of General Motors Ltd. (centre) and Mr. B. E. Terry, technical manager of Ekco Plastics Ltd. (left). The first project for this new machine is the moulding of a liner for a new Frigidaire refrigerator.

Stroke of injection plunger	17 in.
Speed of injection plunger	315 in./min.
Time for complete injection stroke	3½ seconds.
Capacity of hopper ...	22,100 c. in.—approx. 480 lb. polystyrene.
Locking force	1,150 tons.
Tie bar centres ...	56 in. V × 48 in. H.
Distance between tie bars	48½ in. V × 40½ in. H.
Size of mould plates ...	70 in. V × 62 in. H.
Max. mould sizes ...	40 in × 70 in. V, 62 in. × 48 in. H.
Mould opens	42 in.
Combined mould thickness	Max. 44 in., min. 12 in.
Mould adjustment ...	32 in.
Maximum daylight ...	86 in.
Total heating	53½ k.w.
Motors—h.p. & r.p.m.	150 × 720 and 25 × 720.
Pumps used	Vickers-Armstrongs VSG 12/2,000 at 92 gal./min., 2,000 p.s.i. max. Vickers-Armstrongs VSG 6/2,000 at 48 gal./min., 2,000 p.s.i. max. Vickers-Armstrongs VSG 3/3,000 at 16 gal./min., 3,000 p.s.i. max.
Overall approx. weight	73 tons (total)
†Overall machine dimensions—base and injection unit	33 ft. × 6 ft. 8 in. including all projections.
†Power Unit (Minus Starting Gear)	16 ft. × 6 ft. 7 in.

V = Vertical H = Horizontal.

* Dependent on materials and mould construction.
† Approximate dimensions only—please refer to current official installation drawing.
‡ The plasticizing capacity is calculated on the continuous rating of the pre-plasticizing unit.

Levin Cabinets

(*continued from p. 253*)

nance Road, Newquay (L. T. Pryor, director); Dollar-Rae Shopfitters Ltd., 371, Eglinton Street, Glasgow, C.5 (G. D. McIlvain, Sen., managing director; G. McIlvain, Jun.; J. R. Gordon, general manager); Electraire Productions Ltd., 93, Checkett Road, Leicester (A. Humby, managing director); Exeter Refrigeration Ltd., 25, North Street, Exeter (A. T. Bottomley, managing director); Harvey & Hayward Ltd., Kelvinator Corner, New Street, Cardiff (P. I. W. Harvey, managing director; L. Hayward, sales director); Fred Hawkes (Refrigeration) Ltd., Coffee Tavern Lane, Rushden, Northampton (G. P. Robinson, managing director; E. A. Clark, sales manager); H. & E. Engineers Ltd., Varsity Works, 68, Wytham Street, Oxford (Head Office) and Refrigeration Sales Branch: H. & E. Engineers Ltd., Kelvin House, 1 Totteridge Avenue, High Wycombe (M.W. Wood, branch manager); J. T. Herbert Ltd., Key Street, Sittingbourne (H. L. Bennett, sales manager); Ice-Berg Refrigeration Co. Ltd., 147, Union Street, Plymouth (N. W. Smith, sales manager); Refrigeration Co. (Lincolnshire) Ltd., 17, Sincil Street, Lincoln (D. A. Fell, general manager); Masscold Ltd., 2, Pryme Street, Hull (W. G. M. Delany, managing director); Midland Refrigerators Ltd., 266, Broad Street, Birmingham, 1 (S. H. Kilbey, managing director); Playle of Maldon Ltd., Chipping Hill, Witham, Essex (Alfred S. Playle, managing director); P.B. Refrigeration Ltd., 9, Higher Hillgate, Stockport (A. Briggs, managing director; Mrs. J. Briggs, secretary); J. W. Russell Ltd., 18, Queen's Road, Watford (D. T. Russell, managing director; P. R. Leslie, sales manager); Sarum Refrigeration Service, Ashley Road, Salisbury, Wilts (A. Rigiani, managing director).

UP-TO-DATE HANDLING METHODS IN A MODERN STORE

BRITAIN'S first attempt at 100 per cent. palletization and trucking in a cold store built for common user has been made by Andrew Johnson Knudtzon and Associates, Hull. Their new deep freeze (already described in these columns)—used by Hull's fish, meat and food trades—can store 2,000 tons at a temperature of minus 20° F.

The 9,600-sq. ft. Johnson Knudtzon building comprises offices, ammonia freezing plant, pallet storage and two freeze rooms, separated by an insulated partition wall. Rooms can be kept at different temperatures. Store design speeds handling as all operations are conducted at lorry height. Floors are suspended 4 ft. up on sleeper-walls—an idea new to cold storage in this country.

Foodstuffs are handled on and off road transport in a covered loading bay accommodating four vehicles at a time. Lorries back up to a 4 ft.-high platform and are loaded/emptied by roller conveyers. Frozen goods are handled throughout storage in pallet loads of 20 to 25 cwt. Common storage (warehousing of all classes of goods) poses problems when attempting to stack standard pallets but these have been overcome. Fragile or insecure packages are specially protected by steel frames which are superimposed on the pallets.

Trucks to handle the pallet loads were carefully selected. Handling of frozen foodstuffs requires fumeless trucks capable of withstanding temperature variations ranging from 52° of frost to the more normal temperature of the loading bay. To make full use of every available inch of these special, and costly, storage rooms, manoeuvrable high stacking, trucks were imperative.

Standard Yale electric trucks met all these requirements. Models chosen were pallet Worksavers for transporting and fork lift Worksavers for high stacking.

Pallet Worksavers speed horizontal movement of goods from the loading bay to cold storage rooms between which there is direct access at a constant level through a 10 ft.-high super-freeze door. Open during loading and unloading, the door, fitted with an air curtain, maintains store temperature and prevents moisture penetration.

Thermometers often show 52° of frost in the store room where pallet loads are stacked four high by fork lift Worksavers. Truck operators are specially clothed and well gloved—but the easy availability of Worksaver controls present no difficulty of operation.

Trucking and palletization allow an intake of 100 tons of frozen goods a day. In one week, 411 tons were accepted into frozen storage and 367 tons released for selling and distribution—a total of 778 tons trucked in one week ! This is a remarkable achievement for the six Johnson Knudtson warehousemen who comprise the entire handling staff.

Andrew Johnson Knudtson and Associates have solved four major handling problems using mechanical trucks :—

1. They have avoided food contamination by fumes through using electric Worksavers.

2. They have achieved efficient truck operation despite wide temperature variations with standard trucks.

3. The handling gang has been kept down to six men—even with tonnages of 778 a week.

4. Full capacity storage in costly store rooms has been assured by high stacking Worksaver trucks.

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

APRIL MEETING

At the meeting of the Institute to be held at 5.30 p.m. on Thursday, April 2, 1959, in the Memorial Building of the Institute of Marine Engineers, 76, Mark Lane, London, E.C.3, Mr. W. R. Hall, B.SC., will present a paper entitled " The measurement and determination of noise in small refrigerating machines."

The paper outlines practical methods which have been employed for the measurement of noise and its subsequent correction with particular reference to small hermetic compression machines.

For completion a summary is included of the basic units employed in noise level work together with a warning as to the misleading results which may be obtained with a single figure decibel reading on a standard noise level meter. An alternative method developed by Beranck and others is described which summates the noise level in each octave band of frequencies.

A brief review is included of a number of items of equipment which have been employed in the analysis and reduction of noise in refrigerating machines. These items include a standard noise level meter, a dynamometer type frequency analyser, a vibration generator, the stroboflash, the cathode ray oscilloscope and the frequency analyser.

A detailed description of noise level meters, analysers and standard items of noise measuring equipment will not be attempted and the subject matter of the paper is confined more to the application of noise measuring equipment as a research tool for use by the refrigeration engineer. The various sources of noise are listed and their causes and effects examined. In small hermetic machines it was noted that the electric motor was a definite source of noise and on subsequent analysis it was found that the stator and rotor must be concentric for silent operation. Also, care must be exercised during the manufacturing processes that the stator laminations are tightly riveted and windings should not be prone to create a high noise level due to loosely tied wires.

The design of compressor suspension is investigated and a series of tests are described, the object of which was to determine the resonant frequency of a particular suspension.

A comparative test is described in which rubber bushes were found to be superior to helical springs for use as external compressor suspension on sealed hermetic systems. As a corollary to the results of the suspension tests described, it is also of great importance that no pipe line or bracket which is mechanically connected to the compressor has a resonant frequency at, or near, compressor speed, mains frequency or their multiples. A vibration generator may be employed to investigate the characteristics of any particular pipe line or bracket.

The transmission of vibration along pipe lines to the cabinet shell of a self-contained refrigerator is a source of noise and acoustic damping materials may be applied to panels with good effect.

The noise level caused by gas passing through suction and discharge valves is difficult to isolate, but the problem is under investigation and provisional results are included in the paper.

The author concludes by suggesting that no single instrument or meter can provide a complete answer to a noise problem. It is considered that all instrument analyses should be interpreted with due consideration as to their limitations and the information so obtained should be tempered with a practical understanding of the problem under investigation.

SESSIONAL PAPERS PROGRAMME 1958-59

Due to circumstances beyond the Institute's control it has become necessary to make a change in the papers programme for the current session.

According to the published programme, Mr. L. J. Clark was to have read a paper on " Design problems in the storage and handling of liquid methane " at the joint meeting with the Low Temperature Group of the Physical Society on Thursday, May 7, 1959. As Mr. Clark is not yet in a position to present his paper, arrangements have been made for Mr. D. Hurden, B.A., to read a paper on " The handling of cryogenic liquids for rocket engines."

The arrangements for the meeting have not been changed ; it will be a joint meeting with the Low Temperature Group of the Physical Society and will be held at the Institute of Marine Engineers on Thursday, May 7, 1959, commencing at 5.30 p.m.

REFRIGERATION IN AIR-CONDITIONING

At a meeting of the London branch of the Institution of Plant Engineers to be held on Tuesday, May 5, 1959, Engineer-Commander G. C. T. Turner, R.N., will read a paper on " Refrigeration in air-conditioning." The guest chairman at the meeting will be Mr. A. Greenfield, M.B.E., M.INST.R.

The Institution of Plant Engineers have invited members of the Institute to attend the meeting, which will be held at the Royal Society of Arts, John Adam Street, Strand, London, W.C.2., commencing at 7 p.m. ; tea and biscuits will be served at 6.30 p.m.

British Standard for Open and Closed Refrigerated Display Cabinets (B.S. 3053 : 1958)

Several large food manufacturing organizations as well as refrigeration equipment manufacturers were among those interested in the preparation of this first British Standard for open and closed refrigerated display cabinets.

This 23-page publication deals with the materials and performance of the cabinets in relation to an *average* temperature within the cabinet of 0° F. (with a maximum of + 5° F. at any point) above which the temperature of the food in a fully loaded cabinet should not rise.

Materials. Most of the materials are required to be of British Standard quality, *e.g.* corrosion resistance of the electro-plating is governed by compliance with B.S. 1224 and electric cables and cords must likewise comply with the relevant British Standard for them. Again, cabinets must not interfere with radio or television reception—a requirement governed by B.S. 800 " Limits of radio interference."

Performance. There are specified production tests relating to pressure, insulation resistance, earth continuity and the ability of electric circuits to withstand specific high-voltage. These tests, together with normal production tests, are designed to ensure the efficient performance of the cabinet, which is defined by the type tests specified.

Marine Refrigeration*

Dichlorodifluoromethane plant took the lead from CO_2 plant about 1950 in the same way as the latter had superseded cold-air machines some 50 years previously.

Possible disadvantages of the gas include the difficulty of maintaining the system tight, as its low pressure and lack of odour make leaks difficult to trace. Also in contact with a flame or a heated element the gas decomposes and a highly toxic gas is formed which may cause fatal or serious injury in a short time ; the latter feature does not appear to be generally known.

Steam-jet vacuum machinery has been installed on a limited scale from time to time but, owing to the comparatively high minimum temperature of the cooled water, it is unsuitable for most perishable cargoes. A fleet of ships for the carriage of bananas was fitted with the plant in the middle 1930s with cargo capacity in the 150,000 ft.³ range, and some of these ships are still in active service. These ships were generally on a trade which involved a comparatively short voyage.

The machinery has been used in recent years for reducing the temperature of CO_2 liquid in tropical waters (see under CO_2 compressors), and also for air conditioning purposes.

It has generally been accepted that the temperatures are maintainable with less fluctuation with brine circulation than with the direct expansion system.

Direct expansion has increased appreciably during the last 20 years. In some cases each of the cylinders of a multiple-cylinder compressor has been arranged so as to be capable of working independently on a separate suction line with suitable valve arrangements in the suction headers. This enables evaporating temperatures in the cooling appliances of different chambers to suit the temperature required for the particular cargoes carried, with one machine in operation.

Heat exchangers are commonly fitted in the suction lines to dry (superheat) the gas returning to the compressors, the refrigerant liquid between the condenser and the expansion valve being used as the source of heat. Vacuum pumps are often provided for drying out refrigerant systems after parts have been opened up.

To-day the majority of refrigerated spaces are cooled with forced air-circulation.

The volume of air circulated by the cooler fans is generally referred to as the number of changes of the air per hour in the empty cargo space at a stated duct resistance. The figures vary, but for general-purpose installations 25 to 40 changes at the maximum speed of the fan is common practice. In the case of ships specially built for the cooling down and carriage of bananas, the volume of air provided is now appreciably greater ; 60 changes/h is common, but in many cases it has been increased to 90 changes. This is due to the desire to reduce the temperature level of the cargo as rapidly as possible, bearing in mind the relatively high minimum air delivery temperature necessary in order to avoid damage to the cargo.

In a typical early installation there were two air coolers, one on each side of the upper deck which together served three 'tween decks and three lower holds totalling over 200,000 ft.³. The ducting was arranged to deliver air with a fore-and-aft main duct and branches to a duct on the centre line at the bottom of each hold. The suction ducts were arranged athwartships at the top of the holds, with four or five in each, connected to a fore-and-aft main duct to the coolers. The 'tween decks had a fore-and-aft delivery duct with a number of openings into each space on one side and a similar arrangement for the suction on the other. The main delivery and the suction ducts were cross-connected between the two coolers. The fore-and-aft main delivery and suction ducts passed through the ship's bulkheads.

The principal other arrangements of air coolers include : (1) coolers situated on the upper deck serving the holds and 'tween decks below ; (2) coolers arranged on one deck serving that deck and the deck below ; (3) coolers provided in each individual space. The latter arrangement is the most common to-day even in the case of ships with over 60 separate spaces.

With air coolers it is necessary to provide efficient means of defrosting the refrigerant piping, otherwise the flow of air would be impeded and eventually stopped.

With brine circulation, defrosting is dealt with by the circulation of hot brine. With direct expansion air coolers, defrosting is carried out by various methods, including hot gas from the compressor discharge, water spray, and heaters.

Frosting up of cooler coils can be minimized by ensuring airtightness of the chambers including the doors, access plugs, etc. It is, of course, also reduced by avoiding too great a ratio between the load and the surface of the cooler pipes.

Airtight closing appliances have to be provided. In some installations separate fans are fitted for air refreshing purposes.

CO_2 sampling and testing equipment is frequently provided in fruit-carrying ships and also in ships carrying chilled meat from Australia and New Zealand.

A number of portable refrigerated cargo containers have been constructed for ships in the last few years. These are fitted with refrigerating machinery, the electric power being provided from the ships' generators. The refrigerant condensers are air cooled with forced-air circulation.

A brief description of the procedure is as follows :—

The cargo spaces are cooled down if possible to a temperature at least 40° F. below the mean external temperature. This temperature is then maintained steady for a sufficient period to ensure that the insulated structure is at a proper temperature gradient, and afterwards for a further period of 6 to 24 hours according to the external temperature variations. All the necessary data are logged.

The compressor outputs for the relevant condensing and evaporating temperatures for the balance period are obtained from curves previously prepared. The necessary deductions are made for the mechanical heat imput by the fan(s) and brine pump(s), the difference being the measured heat leakage.

A separate estimate is then made of the theoretical heat leakage using the temperature difference for the different surfaces and the theoretical figures for the heat flow per ° F.

(*to be continued*)

* By H. R. Howells delivering the thirty-first Thomas Lowe Gray lecture before The Institution of Mechanical Engineers.

The chairman of S.P.D. welcomes the visitors.

Another Q.-F.F. Depot in Unilever's Marketing System

THE pattern of S.P.D.'s marketing chain throughout the United Kingdom and its relation to the handling of Birds Eye and Regent quick-frozen foods was clearly seen at an " open house " function of that organization last month.

The occasion was the official opening at Reading of the 23rd of the new depots being built for S.P.D. Ltd. throughout the United Kingdom. The depot is situated off the Basingstoke Road, two and a half miles south of Reading.

There are still eight new depots to be brought into operation.

As most readers will know, S.P.D. is the warehousing and distributing associate of Unilever Ltd. and stocks of the well-known brands marketed by companies of the concern are forwarded in bulk to the depot by the producing factories. Deliveries are made by S.P.D. to retailers and wholesalers over an area of approximately 2,000 sq. miles, with an estimated consumer population of 750,000 in accordance with orders received from the marketing companies.

The depot has been planned for the palletization system of unit-load handling, under which, by the use of modern mechanical handling methods, manual work is greatly reduced. Reduced manhandling of packages also ensures that products reach the customer in first-class condition.

The territory served by the depot includes Chipping Norton and Thame in the north, Tidworth and Odiham in the south, with Marlborough and Maidenhead forming the western and eastern extremities.

The premises have been designed to the requirements of S.P.D. Ltd., by Frederick S. Snow & Partners, consulting engineers, and built by W. & C. French Ltd., the electrical installation being designed by the technical division of Unilever Ltd.

The layout follows, on a smaller scale, the design of the Salfords entrepôt already described in these columns.

A 150-ton Birds Eye cold store adjoins the north-eastern corner of the warehouse. This is operated by S.P.D. Ltd. as part of their storage and distribution service.

The depot is designed to accommodate approximately 1,600 tons of user companies' stocks and to distribute up to 400 tons (6,300 deliveries) per week or 800 tons handled in and out.

The chief features of the store are: Main

The chairman of Birds Eye, Mr. J. R. Parratt (*left*), who opened the store, in one of the sub-zero rooms.

Even the largest long-distance refrigerated vans can unload under cover directly into store.

chamber dimensions, 68 ft. 9 in. × 34 ft. 2 in. × 8 ft. high ; 18,500 c.ft. Breakup room dimensions, 22 ft. × 12 ft. 6 in. × 8 ft. high ; 2,200 c.ft. Insulation: 8 in. cork to walls and floor, 6 in. polystyrene plus 2 in. cork for ceiling. Minikay system installed Miniveil installed over main door. Cladding : Aluminium backed with 1½ in. " Therbloc."

The breakup room can be converted to 35° F. Refrigeration : 2 × 15 h.p. Lightfoot's " Freon " compressors. Water-cooled condensers using a water recirculating system pumped through a cooling tower. Grid coil evaporators ceiling mounted only. Anti-frost heave : An electric heating mattress is laid under the floor insulation. A control gear, situated in the engine room, measuring 35 ft. long × 10 ft. wide, situated at the rear of the store.

As already intimated the depot and the low temperature store are fully mechanized for goods handling and the equipment for these duties comprises :—

Handling Equipment :

One high lift truck with side shift attachment (I.T.D. Stacatruc model 424.E/12).

Tare weight with battery, 4 tons 2 cwt. ; Height of lift, 12 ft. ; Length of forks, 40 in. Capacity : 27 cwt. at 24-in. load centres. Truck operating period with fully charged battery : approximately 10 hours.

One powered pallet truck, pedestrian controlled (Lansing Bagnall model P.P. 245/40/27).

Tare weight with battery, 9 cwt. 1 qtr. ; Height of lift, 6 in. ; Length of forks, 40 in. Capacity : 2 tons. Truck operating period with fully charged battery : approximately 10 hours.

Two hand pallet trucks (Lansing Bagnall model HP 5040/27).

Tare weight, 3 cwt. ; Height of lift, 6 in. ; Length of forks, 40 in. Capacity : 2 tons.

One hand pallet truck (Lansing Bagnall model HP 5040/27) specially adapted for cold store working.

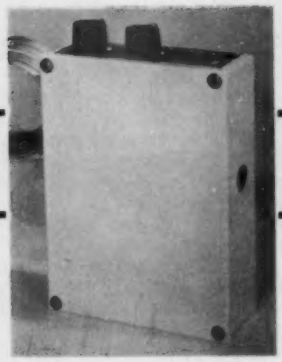
Four bridge plates : one for road unloading. Three of lighter weight for road loading.

Pallet Equipment :

Pallets (40 in. × 48 in. full perimeter, four-way entry, to S.P.D. Ltd.'s specification) : 2,700. Pallet racks (tubular steel and Kee-Klamp construction to S.P.D. Ltd.'s specification) : 30.

It is claimed that the problem of obtaining true colour retention in packaged beef has been solved with the introduction of SS–75 Pliofilm, the transparent packing film developed by Goodyear. The pigments responsible for the colour behaviour of beef, for example, are myoglobin, from the tissue, and hemoglobin, from the blood, which consume oxygen and must, therefore, be replenished constantly to prevent the meat from becoming greyish. A wrapping film with low oxygen permeability would effect such discoloration in a short time. But SS–75 is designed to let oxygen diffuse through the film at just the right degree so that the bright red colour of the meat is maintained throughout the normal display period and even beyond. This gauge of Pliofilm, however, protects good meat from discoloration for as long as 72 hours, especially if the temperature is between 30° and 34° F. Retention of a consistent colour is not only dependent on the packaging film, of course, but can vary with the grade of meat, kind of cut, case temperature and the handling of the meat before it is wrapped.

Commercial and Industrial Section



MANUFACTURERS' AND DISTRIBUTORS' NEWS

T.R.C.'s ANNUAL SALES CONVENTION

The annual sales conference of **Teddington Refrigeration Controls Ltd.** was held at the head office and works, Sunbury-on-Thames, last month.

This two-day event was attended by a full representation of the firm's area managers and salesmen and was presided over by Mr. Stephen S. Sherlock, sales director.

Mr. Sherlock addressed the conference in his own inimitable style, outlining the present high position of confidence enjoyed by T.R.C. products in the industry and speaking of additional outlets for his representatives which had lately come on the industrial and commercial scene.

Mr. T. A. Clibbon, sales manager, refrigeration, gave a talk on controls and new developments, while the design aspects of these components were dealt with by Mr. E. J. Smallbone, assistant chief engineer. Mr. C. A. Butcher, chief inspector, took "production and quality control" as his subject. On the following morning, the heating side of Teddington business was the chosen topic of address and discussion.

In the accompanying picture may be seen the personalities taking part in the conference, although Mr. Smallbone and Mr. Butcher are not shown.

The Teddington sales force, left to right: Mr. D. Ratcliffe, sales office manager; Mrs. White, secretary; Mr. V. C. Miles, sales manager, heating division; Mr. F. Happs, sales manager, P. W. Baker & Sons Ltd.; Mr. V. J. Lewis, sales engineer, refrigeration; Mrs. M. Roberts, secretary to sales director; Mr. M. Rostron, sales engineer, heating; Mr. K. E. Telford, sales representative; Mr. G. J. Cornell, Crane Publicity; Mr. T. A. Clibbon, sales manager, refrigeration; Mr. S. H. Gee, sales representative; Mr. C. Hunter, publicity; Mr. E. Smith, sales representative; Mr. S. S. Sherlock, sales director; Mr. L. Goodier, sales representative; Miss J. Tennent, publicity; Mr. T. W. Cole, sales representative; Mr. R. G. Mitchell, sales representative; Mr. E. C. Thompson, divisional manager, No. 2 division.

COMMERCIAL & INDUSTRIAL

W. A. Taylor Ltd. have opened a sales office in Westminster—at Hope House, 45, Great Peter Street, S.W.1 (telephone VICtoria 6444). The object of opening this new office is to facilitate the handling of queries of a non-technical nature, which have shown evidence of undesirable delay due to the pressure imposed on the Surrey office by the constantly increasing volume of work being handled by the Taylor organization.

* * *

Marco Refrigerators Ltd. held a three-day course for service engineers at Manor Works, Streatham, recently. Twenty-three engineers, representing the service organization of some of Marco's distributors and service dealers throughout the country, attended this course and the enthusiasm of the engineers can best be illustrated by the fact that many had to travel long distances and contend with fog and icy road conditions in order to arrive on time. They were welcomed, on behalf of the managing director, by Marco's general sales manager, Mr. J. D. Young, who gave an outline of the company's service policy and stressed the importance of after-sales service in any industry. Mr. E. A. Sprange, Marco service manager, gave an introductory talk on how the service department operated and the school got under way with a lecture from the chief designer on the "Theory and principles of refrigeration," the service manager assisted by his own engineers putting the theory into practice. Simple electrical practice was dealt with by Marco service engineers who were able to pass much of their own specialized knowledge and experience on to the visitors. The chief laboratory engineer and the chief inspector spoke on workshop and laboratory practice and demonstrations were made in the laboratories and assembly shops as well as with interesting installations set up in the lecture room itself. Initial reluctance on the part of the visitors to ask questions was soon overcome and the staff were kept busy answering a variety of problems. Guest speakers were Mr. T. A. Clibbon, sales manager of Teddington Refrigeration Controls, and Mr. A. R. R. Tenty, manager, refrigeration department, J. Lyons & Co. Ltd. Mr. Clibbon, assisted by two of his representatives, lectured with the aid of a film on "Controls—their function and application." Mr. Tenty, in his address, again stressed the importance of after-sales service and the relationship of the client with service organization. A complete tour of the factory concluded the course. During the tour the visitors were greatly impressed by the high standards of accuracy and constant inspection set in all stages of production and assembly. An examination paper was handed to the engineers with questions set on all aspects of refrigeration. A future service course is planned for later in the year and this is fully justified by the enthusiastic reception given to this one.

* * *

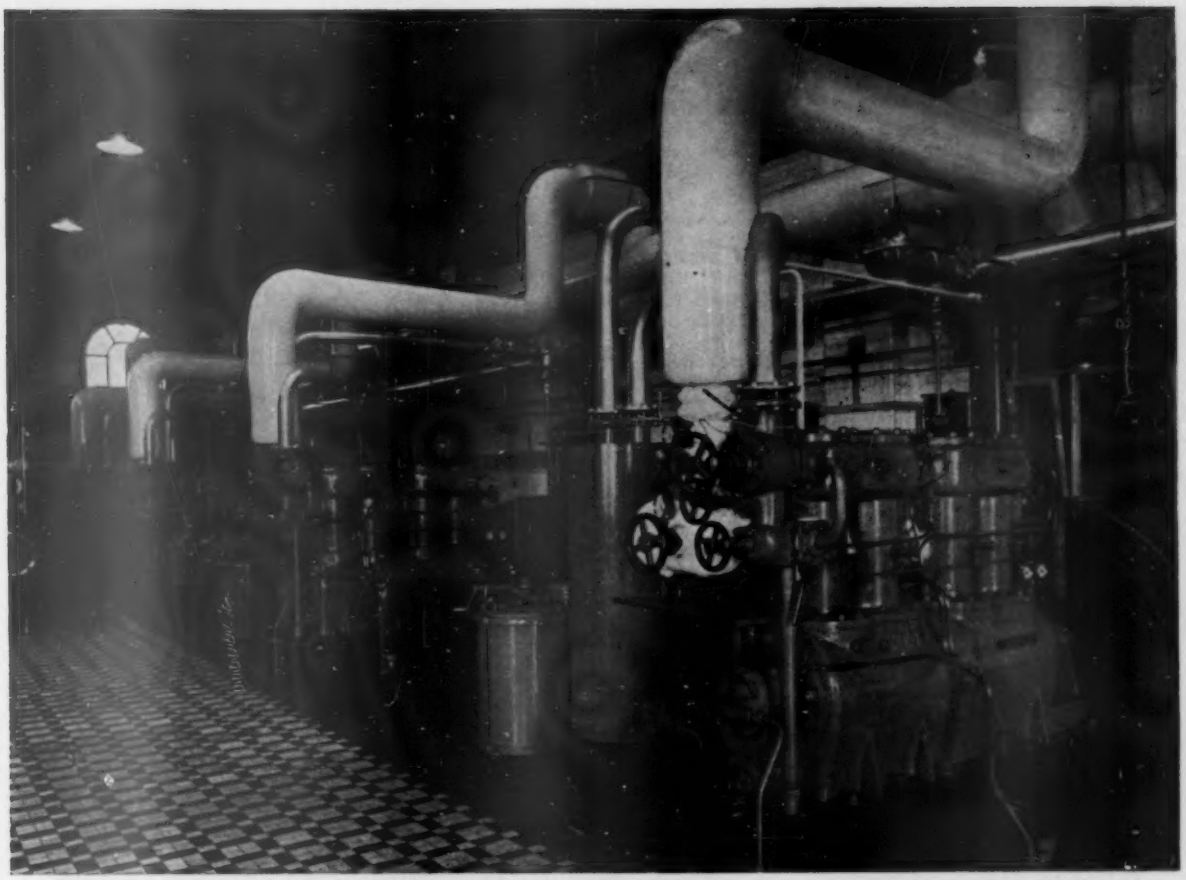
Craig Nicol Ltd., of Glasgow, has been registered as a private limited liability with a capital of £100,000. The new firm will take over the business of Craig Nicol, Pollokshaws Road, Glasgow, builders, wrights, shopfitters and refrigeration equipment manufacturers in Glasgow. Directors—Andrew Nicol, Carmunnock; William Nicol, Tinto Road, Newlands, Glasgow; and Ann Macfarlane Nicol, Carmunnock. Craig Nicol have been very well known in the refrigeration trade in Scotland for many years and have been extending their activities steadily in that field as providers of specialized cabinets, equipment and services to the refrigeration industry and as builders of their own designs of cabinets for a very wide range of purposes.

* * *

Within a few hours of taking delivery of the de Havilland Dove aircraft, this latest Lec plane was off on its first proving flight for the company. With Capt. "Jackie" Moggridge at the controls, Ernie Cowen in the co-pilot's chair, and Geoff. Osborne as passenger, G-ALEC was launched into the air from Croydon Airport at 08.25 hr. Visibility was very poor at this stage and did not improve apart from a glimpse or two of the English Channel and French coastline, since most of the journey took place either in or above thick cloud. At 12.00 hr. G.M.T. the aircraft, flying at 14,500 ft., was clearing the Alps and skimming the cloud tops. Air temperatures were in the region of minus 4° F. (36° below freezing point) with ice forming on the wings and the cockpit covered in frost. Despite this fact, the cabin air temperature was maintained at 45° F. Shortly after this the Alps dropped away and the travellers had their first experience of clear skies and brilliant sunshine as they flew in to land. Spending 56 hours on terra firma during which time 37 hours were employed discussing business and technical problems, the aircraft was once again airborne on its return flight. Leaving at 16.00 hr. G.M.T., and clearing the Alps in daylight, the Dove taxied in to Gatwick Airport at 20.10 hr.

* * *

At the 59th annual general meeting of **Brightside Engineering Holdings Ltd.**, held at Sheffield last month, Mr. Ambrose Firth, J.P., the chairman, said, in part: "Research has continued into this and allied fields, and following development in our own research laboratories and investigation in the U.S.A., the first dual duct high-velocity system of air-conditioning has recently been installed in an office block. It has more than fulfilled expectations. For multi-storey buildings this new system not only permits economies in building construction but provides individual choice of room temperature. I am satisfied that it offers a new standard of comfort allied with a quietness in operation that will certainly be appreciated. . . . Our air-conditioning department con-



Refrigeration

Refrigerating compressors of the monobloc type are widely used in the manufacture and storage of foodstuffs. This installation comprises four 8″ x 8″ quad and an 8″ x 8″ twin monobloc compressor, driven by a total of 675 h.p., and have an installed capacity of 6¼ million B.t.u. per hour. It is installed at the margarine plant of the Co-operative Wholesale Society at Irlam, Manchester. The equipment manufactured by J. & E. Hall ranges from small refrigerated cabinets and compressors of ⅛ h.p. to centrifugal compressors of the largest size in use today.

J. & E. HALL LIMITED
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AP 203

COMMERCIAL & INDUSTRIAL

tinues to expand and I have pleasure in recording an order for services totalling over £500,000 in the Ahmadi Hospital, Kuwait, for the Kuwait Oil Co. Ltd. Whilst our principal business at home continues to come from industry with its many process requirements, demand for air-conditioning in commercial premises is increasing steadily."

* * *

For many years **Cambridge Instrument Co. Ltd.** have had the problem of displaying modern industrial and scientific apparatus in a Georgian setting. Their showroom at 13, Grosvenor Place, London, S.W.1, has now been completely redesigned and redecorated in modern style. Tasteful new furniture has been installed, and, most important of all, the instruments shown are the latest models, mounted on well-designed, easily accessible fixtures and showcases. Lighting problems were solved with the co-operation of The General Electric Co. Ltd., Maple & Co. Ltd. supplied part of the furniture, and H. Benfield Ltd. carried out the decoration. Visitors, particularly from overseas territories, will be welcome, and will be able to discuss their instrument problems with experienced members of the staff. Construction has commenced of the new research laboratory for the company. Overlooking the River Cam and Jesus Green, and within 10 minutes' walk of the centre of Cambridge, the 20,000-sq. ft. building will provide an imposing frontage for the Cambridge factory. The top floor with generous roof lighting will form an ideal design and drawing office, and the three floors below are being fitted with the latest equipment for instrument work involving physics, chemistry, electronics and precision mechanical engineering. The new building heralds a considerable expansion in research, development and design for which staff are currently being recruited. The architects are Edward D. Mills & Partners, designers of the British Industries Pavilion at the Brussels Universal and International Exhibition, 1958, and Messrs. J. Jarvis & Co. the main contractors.

* * *

A new, marine, air-conditioning unit developed by **Thermotank Ltd.**, of Glasgow, can, it is claimed, be used among other purposes to convert existing heating and ventilating systems to full air-conditioning without expensive installation costs and with the minimum of structural alterations. It is the latest addition to the wide range of Thermotank units which have been specifically designed for air-conditioning aboard ship. The new type C unit is intended for mounting on open weather decks, but it can be fitted below deck if required, provided a minimum clear headroom of 7 ft. 6 in. is available for the largest size. The maximum deck space required is 5 ft. 6 in. square. The cooling capacity of the units ranges from 4 tons refrigeration to 20 tons refrigeration, with nominal air circulation of 1,500 c.ft. per min. for the smallest to 5,500 c.ft. per min. for the largest.

* * *

Frostaire Refrigeration Co. Ltd. took another step forward in their programme of expansion last month. On channel nine "On View" was presented by the famous television personality Miss Margot Lovell who had some very kind words to say about the success and progress of the company. The studios at Associated Rediffusion, Television House, London, were most attractively laid out with an Eldwood frozen food cabinet model 137, fully dressed with frozen food and gaily illuminated; alongside stood the Lec model R.C.6 three-quarter vision display counter also dressed and illuminated. It was reported by the managing director of Frostaire that the results of the television venture to date have been most gratifying and he wishes to convey the sincere thanks of the management and staff of Frostaire to Miss Margot Lovell and all persons responsible for the first-class performance given on this, Frostaire's television début.

Frostaire on television.

* * *

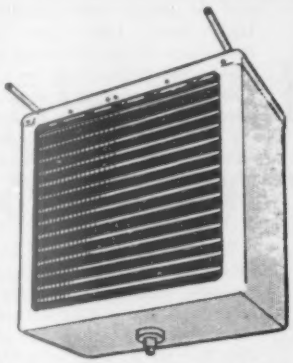
"J.D." Insulating Co. Ltd. have been successful in securing the order from the shipbuilders of the P. and O. liner *Oriana* (Vickers-Armstrongs Ltd.) for the insulation of holds, 'tween decks, bulk stores, evaporator room and machinery space, also ship's provision chambers.

* * *

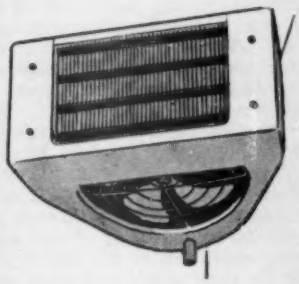
A new automatic A.C. starter for the direct switching of squirrel cage motors up to 7½ h.p. has just been launched onto the market by **Dewhurst & Partner**, of Hounslow, manufacturers of electric remote control equipment. Called the Dupar TFK starter, the new unit is claimed to be the only one in its class to incorporate a neon running indicator lamp, single phasing and overload protection for the motor windings and silver contacts as standard. It is intended for heavy duty operation and has been produced with an eye to the practical requirements both of equipment manufacturers, who need a reliable supply of good quality starters for

Kelvinator

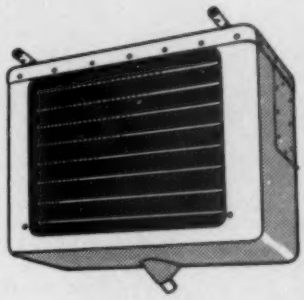
have all the answers



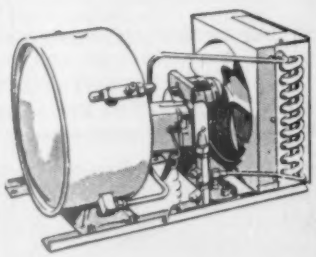
LTE COOLERS



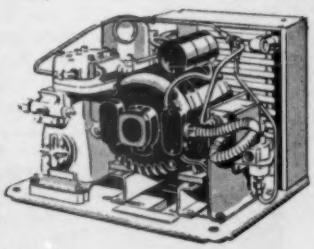
CFC COOLERS



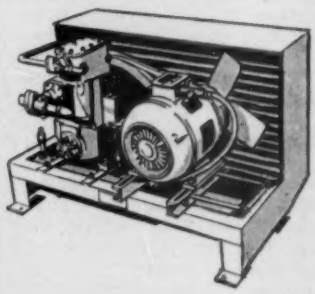
HTE COOLERS



SEALED CONDENSING UNITS



WATER COOLED CONDENSING UNITS



AIR COOLED CONDENSING UNITS

We've been in the refrigeration business now for more than 40 years —but our real business is helping you to profit by our experience. Send off the coupon and we'll be pleased to show you how to go about it.

Kelvinator

FINEST MODERN REFRIGERATION

TO: KELVINATOR LTD.,
GREAT WEST ROAD, LONDON, W.4.

Please send me details of the above units.

NAME .....

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I am particularly interested in
COOLERS/CONDENSING UNITS MR 8

COMMERCIAL & INDUSTRIAL

incorporating in motor-operated plant; and plant engineers, who want an economical starter to fit their own motor installations. To these ends the deep-drawn steel case has been so designed that it can be wall or pillar mounted either singly or in tandem and, if necessary, the whole internal operating unit can be obtained independently of the case for mounting as required in a separate enclosure. A second model is available in the same range. This is the TFW reversing starter which is based on the same design and uses the same standard components as the TFK type. Both models are finished in an attractive silver hammer stoved enamel and are protected against dust and damp. A Neoprene seal is provided between the two halves of the steel case.

* * *

The **Vendo Division** of Joseph Sankey & Sons Ltd. sold over 1,000 milk merchandising machines in 1958 (over 100 were sold at the Dairy Show). The machine is refrigerated by a ¼-h.p. sealed refrigeration unit which maintains the cartons in the Vendo at an ideal temperature of 35 to 40 degrees. This is effected by cold air being continually circulated through the machine.

* * *

Metropolitan-Vickers Electrical Co. Ltd. announces the appointment of Mr. H. West, ASSOC.M.C.T., HON. M.SC. (MANCHESTER), M.I.MECH.E., M.I.E.E., Member A.M.E.M.E., as assistant managing director. Mr. West has ceased to act as director of electrical engineering. Mr. West joined Metropolitan-Vickers as an apprentice in 1918. Much of his early work was on motor development, and in 1940 he became chief engineer, motor and welding departments. In 1946 he was appointed assistant to the chief electrical engineer of the company; in 1949 he became chief electrical engineer, and was appointed to the board in 1951.

* * *

Both the life and the performance of a gland packing are adversely affected if it is not properly installed. A stuffing box in which remain vestiges of an old, worn gland packing is frequently the cause of premature failure of the new packing which has replaced the old one. The same conditions are an even more frequent reason for the failure of a gland packing properly and efficiently to seal against leakage from a gland. When it is necessary to remove an old, worn packing, properly designed tools are indispensable. In order to emphasize just how important it is to use well-designed packing extractor tools, **Crane Packing Ltd.**, of Berwick Avenue, Slough, Bucks, the world's leading specialist manufacturers of gland packings, will supply *free and postage paid* a pair of 7-in. Crane flexible packing extractors. The offer is being made to all *bona fide* users of gland packings who would like to test the usefulness and efficiency of these tools. These extractors have been specially designed by Crane engineers. They are packed in an attractive and useful box, and with each pair of extractors there is enclosed a prepaid reply card relating to the supply of trial sevenring assemblies of any one of three of the most widely used gland packings from the Crane range.

* * *

R. A. Lister & Co. Ltd., the well-known West of England engineering company, announce that Mr. P. Mackay-James, the director and general manager of their subsidiary company, Blackstone & Co. Ltd., and Mr. F. E. Blackstone, a director of Blackstone & Co. Ltd. and other subsidiary companies, have been appointed to the board of R. A. Lister & Co. Ltd.

A new publication, "Bitumen Coatings for Thermal Insulation," by **Berry Wiggins & Co. Ltd.**, should prove very valuable. The 35 pages contained in this book should assist those interested in the production and erection of thermal insulation, and the concise specifications, covering capacity tables and other information of products and methods, makes the publication an extremely useful book of reference to have at hand. As new materials come into use or new methods of insulation are adopted, the loose-leaf form of the book allows it to be easily kept up to date.

* * *

Expandite Ltd., well known as manufacturers of sealing compounds, jointing and waterproofing materials and anti-corrosive treatments, was founded in 1934 and thus celebrated their silver jubilee on February 24, 1959. During this period of 25 years through continuous research and development, they have produced a wide range of materials for civil engineering, building and allied industries as well as for motor and accessory manufacturers, statutory undertakings and the like. The company was founded by Mr. Bertram Watson who to-day is their chairman and managing director.

Frozen foods featured at Newquay Show. Picture shows the stand which Eskimo Foods Ltd. shared with Cornwall Refrigeration Ltd. at the recent catering exhibition at Newquay.

Problems solved from cold NO. 4 IN A SERIES

By Appointment to Her Majesty the Queen
Manufacturers of refrigerating machinery
Pressed Steel Company Limited

How we beat the coldroom bogey

The problem—costly breakdowns

Coldrooms must be kept cold at all costs. Or must they? At Prestcold we think otherwise. We maintain that coldrooms must be kept cold *at less cost*. For, when flywheels and pulleys work loose, or belts break or crankshaft seals give trouble, it's small comfort to the owner that his motor can be quickly repaired. Repairs and servicing are going to cost him money in the end, and he knows it.

THE PRESTCOLD SOLUTION—THE SUPER PRESMETIC CONDENSING UNIT

On the principle that prevention is cheaper than cure, we decided to develop a really reliable compressor unit motor. And we did it—in the Super Presmetic series. To be technical, the Super Presmetic is a direct-drive motor compressor. To be plain, it does away with all the parts that cause most trouble—driving belts, crankshaft seals, pulleys, flywheels. It is reliable indeed, *and the motor compressor is guaranteed for five years.*

MONEY, SPACE AND TROUBLE SAVED

Its advantages don't end there, either. To money saved on less maintenance, add the money saved on running costs, because less power is lost in friction. Then add the space saved, because the Super Presmetic is extremely compact. Finally, subtract a whole lot of trouble—in oiling and cleaning, checking and worrying.

CAN PRESTCOLD HELP YOU?

If you have a problem in refrigeration you'll probably find that existing Prestcold equipment will deal with it. Because all our equipment comes from a long line of intense research. But even if yours is an entirely unique problem please let us know about it. We shall be glad to help. Write to your Prestcold distributor, or to Prestcold Commercial Sales Department, Cowley, Oxford.

FOR FRESH IDEAS...IT'S

Prestcold

PRESTCOLD DIVISION
PRESSED STEEL COMPANY LIMITED, COWLEY, OXFORD

COMMERCIAL & INDUSTRIAL

Trade insignia including a refrigeration maker's monogram, moulded in I.C.I.'s "Diakon" by Wilmot Breedon Ltd. The mouldings are metallised and sprayed on the cavited reverse to produce an attractive three-dimensional effect in colour.

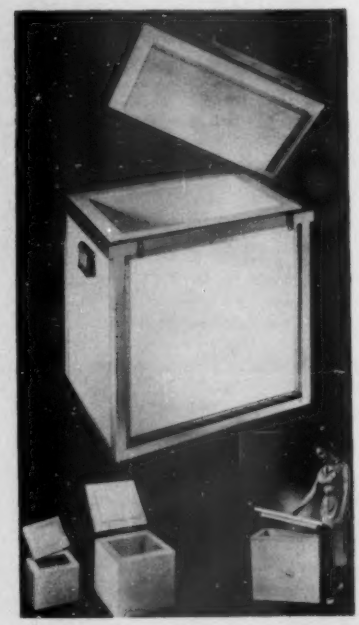
* * *

Universal Metal Products Ltd. is celebrating its silver jubilee. Formed in 1934 by Mr. E. G. Wertheimer for the manufacture of tin and lead collapsible tubes, the firm commenced production with a few machines and a handful of employees. The company is a wholly owned subsidiary of the Winterbottom Book Cloth Co. Ltd. and Mr. Wertheimer is the managing director and also a director of the parent company. To-day the company employs approximately 1,200 people and it can be said that it is the biggest single tube production unit in the Commonwealth, specializing in the production of soft metal tubes, aluminium tubes and rigid containers. The production is used as a packaging medium for toothpaste, cosmetics, food and a variety of other products.

* * *

The Glo-Brite Products Inc. in the United States has recently developed, and Chari-Vari House put on the market, an entirely new type and highly versatile cubic foot plastic foam portable frozen food transporter, called the " Freez-Safe." The new transporter, when loaded with frozen foods, keeps the merchandise solidly frozen with just a few degrees of temperature rise for a full 72-hour (three-day) period by using a small amount of dry ice. The foam insulation core of the unit is one of the largest moulded units of its kind ever made, being of one piece construction and weighing 14 lb.

Refrigeration engineers designed the foam-insulation walls, top and bottom, of 2¼-in. thickness ; the outside measurements are 28 in. by 19 in. by 28 in. The net cubic inside measurements are 23 in. by 14 in. by 23 in., giving the cubic capacity of 5 c.ft. net. The 2¼-in. walls of foam are equivalent to 4 in. of cork insulation yet weighs only one-fifth that of cork. Designed specifically to carry up to 175 lb. of frozen foods well within safety requirements, the new foam plastic "Freez-Safe" transporter meets the growing needs for distributions transportation and storage of frozen foods, meats, dairy products, pharmaceuticals, antibiotics and other material demanding sustained low temperatures within safe temperature limits. The "Freez-Safe" transporter is manufactured with several types of *outer* shells : U.S. Royalite, tough, industrial plastics ; and aluminium or stainless steel. Inside liners are of U.S. Royalite, durable, seamless plastic approved by the U.S. Department of Agriculture for food handling and transport. In addition to its uses as a transporter and storage unit, it can become a very attractive frozen food island displayer and merchandiser in supermarkets and retail grocery establishments, hospitals, institutions and commissaries.



* * *

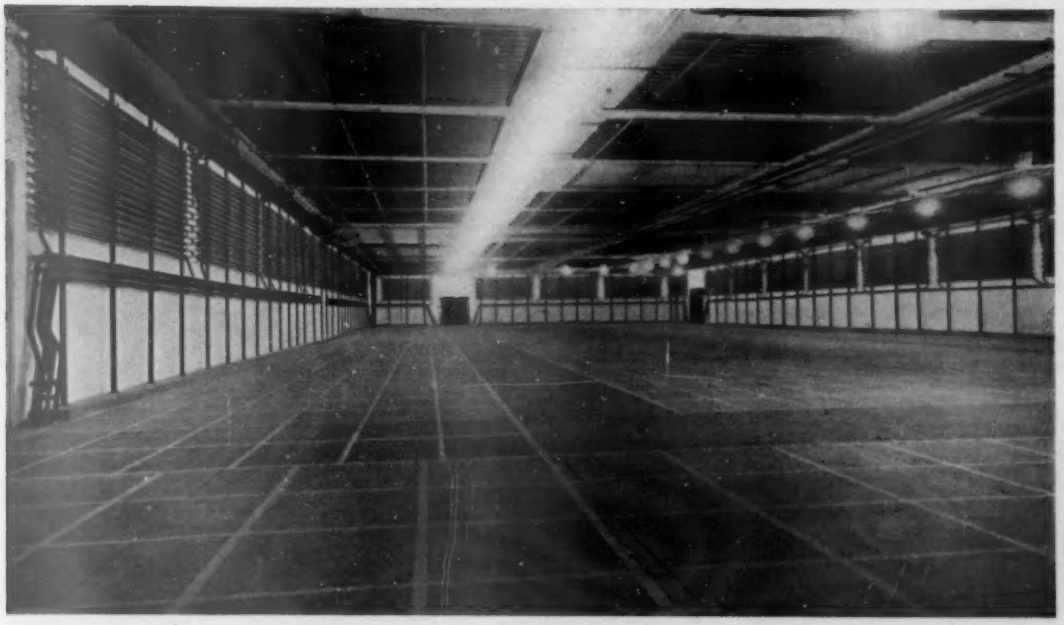
In the new **American Package Machinery Co.'s** FA series of frozen food packaging machines, the automatic paper stop, which halts the paper-feeding mechanism when no package is in place, is activated by a " feeler " which touches each package at its ends instead of at the top and exerts only 1 oz. of pressure—important when soft, light packages or goods are being wrapped. Large end-heater plates are spring floated to compensate for slight variations in the size of cartons being wrapped.

* * *

Mr. James D. Furse, 40, has been appointed manager of the refrigeration department of W. J. Furse & Co. Ltd., Nottingham (member of the E.V. Industrials Group), following the death, in a road accident, of the previous manager, Mr. John French. The department handles the sales and service of Frigidaire equipment for most of Nottinghamshire, Derbyshire and Lincolnshire. The company was one of the first distributors for Frigidaire to be appointed in the United Kingdom. Mr. James Furse joined the company as a contracts engineer in 1948 and was chief contracts engineer before taking up his present appointment. He is a graduate of the Institute of Electrical Engineers and served an apprenticeship at B.T.H. (Rugby). He also served in the Royal Artillery throughout the war, retiring with the rank of major.

Mr. J. D. Furse.

"WIDER STILL AND WIDER-



SHALL THY BOUNDS BE SET"

In 1956 we installed the refrigerating plant for the Birds Eye frozen food store at Great Yarmouth — a single room of 250,000 cubic feet and at that time one of the largest single span storage rooms in Europe. We have just completed the installation of Birds Eye's newest store at Lowestoft — also single span, also low temperature, *BUT MORE THAN TWICE THE SIZE OF THE GREAT YARMOUTH STORE.* Over 14 miles of steel tubing, wound into grids, line the walls and ceiling of the cold chamber and some idea of the immensity of this room can be gained from the fact that 140 London buses could be parked comfortably inside it. These are only two — even if the two largest — of more than 60 cold rooms which we have been privileged to equip for Birds Eye during the past eight years and we are proud of the knowledge that the major part of our business is made up of such repeat orders from world leaders in many industries.

People who really know and who make sure that each job is the utmost value for money come to Lightfoot-again and again

LIGHTFOOT
REFRIGERATION

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FWS

Refrigeration Servicemen's Association

By M. R. HADRYS, secretary

THE meeting held on Tuesday, February 10, was an important one for the Refrigeration Servicemen's Association. At this meeting, the proposed by-laws previously distributed at the January meeting were adopted. Copies sent to absent members had received their approval. This important step places the R.S.A. on a firm footing as a properly constituted body. The by-laws, suitably printed, will now be distributed to members. The Institute of Refrigeration have promised support and guidance as and when required. Although applications for membership have steadily increased since the first meeting in October, 1958, it is expected that the above events will cause a sharp increase in these applications.

The use of the original badge of the R.S.A. has been discontinued and the committee announce that a competition is being held among members to design a suitable badge for the Association. The design should incorporate a motto referring to the aim of the Association. Designs can be in the form of freehand sketches or drawings, and to show detail, neat entries must be not less than 4 in. in diameter. The competitor's name and address should be clearly printed at the foot of the entry which should be addressed to the hon secretary, 57, May Avenue, Canvey Island, Essex, to arrive not later than the last post Tuesday, June 30, 1959. The designer of the winning entry will receive a useful hand tool kit presented by Dean & Woods Ltd.

The subject of this month's lecture was " Modern training methods for the serviceman " by Mr. C. J. Woodmore of Frigidaire, who emphasized the usefulness of visual aids in training. This was proved when he demonstrated the many types of equipment displayed, including the Viso-trainer containing a glass tube evaporator. When operated, large dial gauges and thermometers enable members to clearly see pressure and temperature changes. The boiling off of the refrigerant, the miscibility of oil with " Freon " and the superheat setting of the T.E.V. were clearly seen. Although not

The chairman, Commander M. B. F. Ranken, addressing the meeting. On his right is the secretary Mr. M. R. Hadrys.

Mr. C. J. Woodmore giving his lecture, aided by a full range of Frigidaire servicing equipment.

REFRIGERATION

BY WILLIAMS

Part of the low temperature refrigeration plant installed for Messrs. Eskimo Foods Limited, Cleethorpes, Lincolnshire

G. Williams Engineering Company Limited were responsible for the design and installation of the complete plant which has a total capacity of 1,200,000 B.Th.U.'s per hour at -35°F.

Six Williams Contact Plate Freezers are shown and space is reserved for a further two units.

For quick freezing and storage plants consult Williams.

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demonstrated, an A.E.V. was fitted to enable varying conditions for either type of valve to be shown during training. Always a difficult theory to prove is the pressure/temperature relationship of a refrigerant. Using water in a glass flask connected to a vacuum pump, the trainee is shown that under decreasing pressures the water boiled at lower temperatures. Another model demonstrated how temperature changes on the phial modulate a thermostatic expansion valve. The boiling point of a refrigerant was proved. The electrical side of servicing had not been forgotten. A cut-away model of a relay was operated under varying conditions with particular attention shown to the bi-metal strip. In addition there were many cut-away models to enable the trainee to clearly follow explanations given.

It was pointed out that although visual aids are of inestimable value in training, the fundamentals and principles of refrigeration must be taught to enable the student completely to understand the operation of refrigeration equipment. These are illustrated in films that were shown at the conclusion of the lecture. Being trained in this interesting manner, the trainee can quickly learn to diagnose faults in order to carry out the type of service that eliminates "call-backs." Experience takes time but proper training does ensure that good habits are formed ; one of these being to purge gauge lines when fitting gauges.

It was stated that many who benefit with this type of training are unable to fully express their knowledge at the usual type of examination. To cater for this type of student, the examination paper is of a "quiz" nature. Each question has several answers of which only one is correct. This method has been found most successful.

The behaviour and appearance of the serviceman were mentioned as it is believed that these coupled with his workmanship have a direct bearing on the relationship between his company and the customer. Good behaviour, neat appearance and such training as has been described make the serviceman an asset to his company in maintaining customer goodwill.

After a very instructive lecture, further interest was shown as the meeting closed with both members and visitors operating at first hand the demonstration models.

Domestic Science in the West

SITUATED in the pleasant north-eastern suburbs of the ancient city of Gloucester amid green playing fields, stands the new building of the Gloucestershire Training College of Domestic Science which opened for students last September. Previous to this time, it was situated in an older part of Gloucester and originally founded as a school of cookery in 1891, so that it can claim to have considerable experience and authority in all that it teaches.

Approximately two hundred and twenty full-time resident students are catered for, who come from all over the country, and the aim of the college is to give its students a broad educational background and the necessary technical skill in those subjects for which they are qualifying. It is linked with the University of Bristol and forms a constituent college of the University Institute of Education, and offers a three-year teacher training course; a two-year Institutional Management course; a one-year post-graduate course for the teacher certificate for graduates in domestic science or household and social science, and, in collaboration with the University of Bristol, a course for the degree of bachelor of science (domestic science). In addition to this very varied curriculum it hopes to offer, in the future, a course for a diploma in dietetics.

For such wide and varied subjects as these it will be seen that extensive departments are necessary, and here they are provided to a superlative degree. There are practical rooms for all branches of housecraft, lecture rooms, laboratories, art and needlework rooms and kitchens for catering work, each with the latest and most modern equipment.

In such an establishment as this the use of refrigeration is of course essential, and the Prestcold distributors for that area, Gardiner, Sons and Company of Bristol, have supplied a variety of equipment —all of which plays its part in the education of these future teachers and catering experts. A large provisions coldroom has been installed together with a Prestcold deep-freeze refrigerator, the latter being used for experimental purposes as well as for its everyday uses, while a 17 c.ft. service cabinet in the catering kitchen and domestic models in some of the subsidiary kitchens are all used to very good effect.

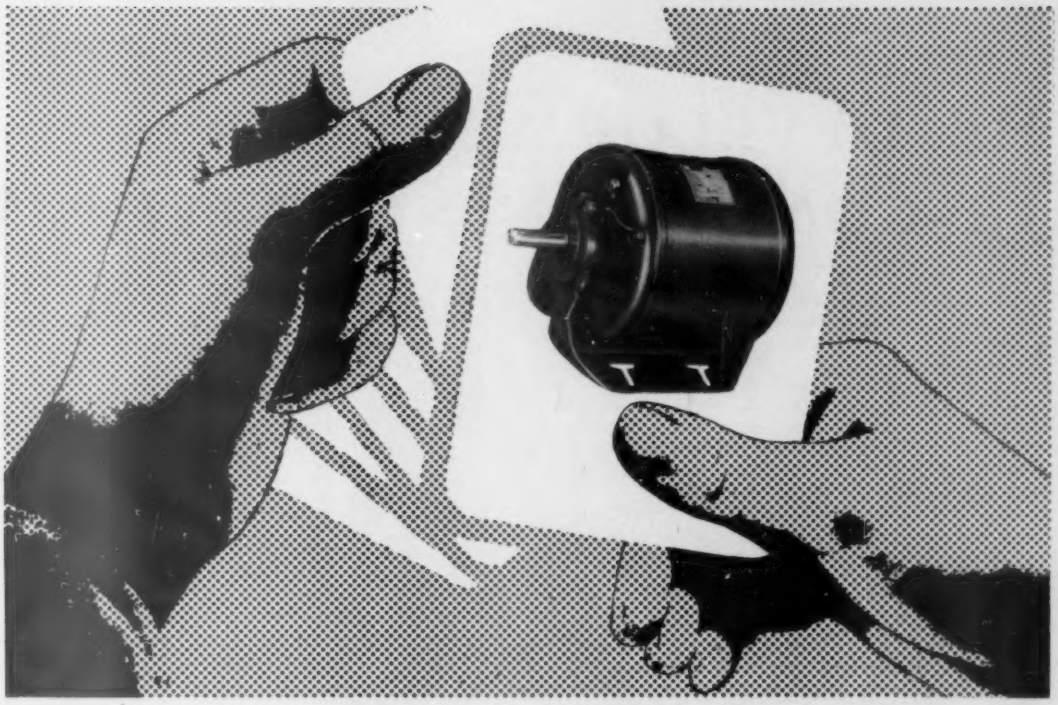
Entering through the main doors one is immediately impressed by the spaciousness of the main halls. Parquet floors and modern lighting enhance the visitor's first view of the interior, whilst a glimpse of the long, gleaming corridors opening on the airy well-lit "classrooms," confirm one's first impression that in this ultra-modern, three-storey building, no effort has been spared in making it the finest possible.

Award of Benjamin Franklin Medal

WITH the approval of H.R.H. The Duke of Edinburgh, president of the society, the Benjamin Franklin Medal for 1959 has been awarded to Mr. Henry George Nelson, M.A., M.I.C.E., M.I.MECH.E., M.I.E.E., Managing Director of The English Electric Co. Ltd., "for his work in scientific industrial development." The award is made annually "to individuals who have attained early distinction, with promise of future achievement, in the promotion of arts, manufactures and commerce."

Educated at Oundle and King's College, Cambridge, Mr. Nelson obtained his engineering training in England, France and Switzerland and joined The English Electric Company as superintendent of their Preston Works in 1939. In 1942 he was appointed managing director of D. Napier and Son, and in 1949 deputy managing director of The English Electric Company. He succeeded his father, Sir George Nelson, BART., as Managing Director in 1956. He is 42 years of age.

This is the third award of the Benjamin Franklin Medal, which was instituted in 1956 to commemorate the 250th anniversary of Franklin's birth and his election to membership of the Society of Arts in 1756. The two previous recipients were Professor F. C. Williams, F.R.S., in 1957, and Mr. Peter Ustinov last year.



An entirely new suit in F.H.P. motors

You cannot interfere with a production line every time a new idea or a possible improvement to the product turns up. You have to let these ideas accumulate and then, in one clean sweep, incorporate the lot—or as many as are compatible—in a new design.

That is what has just happened to Crompton Parkinson F.H.P. motors. The new Series 'T' is the result of such an accumulation of experience, ideas, possibilities suggested by new materials, and so forth, that has been building up for years. The new motors are better looking, better ventilated and, if possible, even more reliable than their very popular predecessors.

Here are some of their points:—

1. Strength Rolled steel welded carcase supported by continuous full core diameter; short, stout endshields of extremely rigid design.

2. Squirrel Cage Rotor Cast under closely controlled conditions with subsequent heat treatment resulting in maximum torques and uniformity in performance.

3. Centrifugal Gear and O.C. Switch Completely new long-life design with minimum number of working parts; robust, quiet, positive and troublefree in operation.

4. Bearings 'Marathon' Mark III Sleeve Bearings contain enough oil absorbed in felt specially made for the job for two years running under normal operating conditions. Pre-loaded ball-bearings are also available.

5. Cool Running A new system of ventilation with a fan at both ends of the motor gives the maximum airflow over the windings with a minimum of noise, and keeps the motor temperature low

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THE DEVELOPMENT OF AIR-CONDITIONING IN SHIPS*

A short historical introduction is followed by a breakdown of the spaces in a ship from the point of view of air treatment. One section only, namely living accommodation, is then considered.

The physiological effects of surrounding air conditions are discussed and human comfort related to a scale known as "effective temperature."

A typical air-conditioning calculation is given for a ship's dining saloon, both for cooling and heating cycle, and design conditions are suggested for various ship routes. Modern methods of air-conditioning and controls are briefly described, and reference is made to developments in refrigeration plant.

The practical problems of the air-conditioning engineer are indicated, together with the associated problems of the naval architect and superintendent engineer.

Certain conclusions and further developments are suggested, and the appendix includes a glossary of terms, psychrometric chart and pictures of ship installations, together with references for further study.

By

S. J. JONES, B.Sc.
(Member)†

and

J. K. W. MacVICAR
(Associate)‡

Historical

THERE seems little doubt that the earlier civilizations were based in climatic conditions of a temperate and pleasant nature, and the discovery of fire and the means of producing it permitted voyages of discovery into less clement lands, where warmth in the form of fires was produced by man for his additional comfort and well-being. It would also seem to be an historical fact that these civilizations were aware of one method of cooling, although it is unlikely that the reason for this was understood. This refers, of course, to the porous pot of water, from which some water evaporates and extracts its latent heat of evaporation from the remainder. A more modern form of this is the " butter cooler " and, more recently, the vacuum refrigeration plant.

It was not until 1854, however, that Professor Thompson, later Lord Kelvin, and the father of thermodynamics as the subject is known to-day, propounded the theory on which modern refrigeration is based. Furthermore, at that time he suggested the possibilities of the application of the heat pump, which over the past decade has been applied on an ever-increasing scale.

W. H. Glass points out in his paper, " Air-conditioning in ships' passenger and cargo spaces "[1] that probably the first application of so called " comfort cooling " in ships was in 1903 and was fitted in the *Kumono Maru* by the late A. W. Stewart. This, he states, was followed in 1914 by installations in the *Cap Polonio* for the Hamburg South American Steam Ship Company, and the s.s. *Aisie* for Chargeurs Réunis. It was, however, considered at that time that the drain on the ship's refrigeration plant was too heavy to justify its inclusion in later vessels.

Glass points out that the term " air-conditioning " seems to have originated in connexion with patents taken out by Stuart W. Cramer in America in 1906. It is essential, therefore, to have a clear understanding of the term " air-conditioning." In the broadest sense all heating, cooling, and ventilating systems affect in one way or another the condition of the air in the space for which they are used, but for the purpose of this paper the term " air-conditioning " refers to the production and control of temperature, humidity, air purity and movement as they affect human comfort.

It will be obvious that where large numbers of people are congregated together in an enclosed space, the condition of the surrounding air can in a short time become unpleasant, and there is little doubt that a tremendous fillip was given to air-conditioning by its application to cinemas and the theatres in America in the 1930s. These advances in the comfort and well-being of patrons made demands for similar standards on ships, particularly those used by American travellers.

It is not surprising, therefore, that the first of the more modern applications was made in passenger ship public rooms, principally dining saloons, while the rest of the vessel was mechanically ventilated with atmospheric air. Gradual increases in the standards of comfort demanded by the travelling public called for increased standards of ventilation with diminishing returns, until consideration had to be given to air-conditioning the lesser public rooms, then passenger accommodation, and finally crew accommodation. The stage has now been reached where to build a tropics-going ship without full air-conditioning would mean that she would be out of date before she makes her maiden voyage.

The Problem

From the point of view of air treatment, a ship divides itself into four separate categories, as follows :—

(1) Living accommodation.
(2) Machinery spaces.
(3) Spaces such as galleys where large heat dissipation is likely to exist.
(4) Cargo spaces.

In turn these categories are further broken down as follows:—

(1) (*a*) Public rooms.
    (*b*) Private accommodation.
    (*c*) Public lavatories, wash places, etc.
(2) (*a*) Boiler rooms.
    (*b*) Main machinery space or engine room.
    (*c*) Auxiliary machinery spaces (generator rooms, etc.).
(3) (*a*) Galleys proper.
    (*b*) Galley dependencies.
(4) (*a*) General cargo spaces.
    (*b*) Refrigerated cargo spaces.
    (*c*) Special cargo spaces.

Apart from these categories the general ship subdivision, from the point of view of watertight integrity and fireproofing, must also be duly considered.

* Paper read before a joint meeting of the Institute of Marine Engineers and The Institution of Naval Architects in London on January 13.

† Southern Area Manager and Director of Thermotank Ltd.
‡ General Manager and Director, Thermotank Ltd.

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Lustrex General Purpose—like all other grades of Monsanto Lustrex — is a HIGH-QUALITY polystyrene, and refrigerator boxes moulded in it are first-class, crystal-clear products. That's why you should always insist on Lustrex General Purpose.

- *Lustrex General Purpose is also available in a wide range of standard colours; or, special colours can be accurately matched within a few days.*
- *There is a grade of Lustrex for every job in polystyrene.*

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To deal adequately with all three sections is not possible in one paper and it is therefore section (1) only which the authors intend to cover at this time.

Physiological Considerations

In order to understand the problem fully, an appreciation of the heat balance system of the human body is necessary, so that it is possible to see how variations in the properties of air have a bearing on the normal body functions.

Quite a good analogy can be made between the human body and the main machinery of a ship. The energy of the body is derived from food by the oxidation and conversion of carbohydrates, etc., into sugars. In breathing and eating, oxygen and carbohydrates are provided for this purpose and this roughly corresponds with the combustion air and fuel. The first conversion takes place in the stomach and the useful products, sugars, are circulated from this source via the blood stream.

This corresponds with boiler and steam lines on a ship. The energizing material in the blood stream sets brain and muscles in motion in the same way as steam applied to engines, and so the body derives its propellent to brain and muscle.

Like all machines a peak efficiency is reached at definite temperatures, and the body normally functions best at a condition of 98·4° F. This means that under varying conditions of activity and for the most efficient working of the organs of the body, this temperature must be maintained. To preserve the heat balance the body has three methods at work to stabilize this condition.

(1) It can radiate or absorb heat.
(2) It can lose or gain heat by convection.
(3) It can control moisture evaporation by the opening and closing of sweat glands or pores, thus increasing or decreasing loss of heat by evaporation of moisture from the skin.

These facts give the clues straight away as to the properties of air governing the heat balance, and they are listed as follows :—

(*a*) Oxygen must be available to initiate the energy cycle from food.
(*b*) Temperature variations will affect loss or gain by radiation and convection.
(*c*) Humidity will affect loss of heat by evaporation.
(*d*) Air movement increases the evaporation and convection effect.

The quantity of heat to be dissipated from the body by these means varies according to the person's activity, but in general ship calculations may be taken as approximately 400 B.t.u. per hour.

From the point of view of air purity oxygen must always be available for life to exist, but other ventilation factors associated with air-conditioning in ships assure an ample supply of oxygen for life, and this does not normally enter into the problems involved in any significant way, except in special cases such as submarines and other naval vessels.

The other three factors affecting comfort must, however, be given further thought, as they are in many ways dependent one upon the other. For this reason air-conditioning engineers and physiologists both in America and the United Kingdom have carried out a considerable amount of research on the human reactions to variations of temperature, humidity and air movement, and by the accumulation of data based on these reactions it has been possible to reduce the effects of the three factors to a single comfort index termed the " effective temperature scale." This scale is based on the interrelation of these three items from the point of view of bodily comfort, compared with a temperature of still air at 100 per cent. humidity.

The manner in which these data have been prepared, namely by the subjection of large numbers of people to varying conditions of temperature and humidity, and by recording their physical sensations, cannot be considered as an exact scientific relation ; *e.g.* 80° F. at 100 per cent. humidity cannot be exactly the same as 88° F. and 50 per cent. humidity, since some different sensation must be expected with a drier condition at 88° F. However, from the point of view of general comfort, the large majority of subjects considered the one to be as comfortable as the other.

A word must now be added in connexion with the so-called " comfort zones," and it will be obvious that there will be a limited range of conditions within which body comfort will exist. Unfortunately this varies both individually and nationally and again between winter and summer. The two arbitrary zones are indicated on the chart, for Britons, one for summer and one for winter. The reason for this variation is a natural tendency for the individual to become acclimatized physically and also to adapt himself by variation of dress.

When air-conditioning is applied, care must be exercised in order to avoid sudden excessive changes, and taking an internal relative humidity condition of, say, 50 per cent., the temperature drop should be related to the prevailing outside conditions to avoid shock effect, more particularly when the outside humidity is high. Under such conditions, which usually prevail at sea in tropical climates, the inside temperature condition to be maintained can be assessed from charts.

(The authors then showed how variations of ambient conditions can be influenced by the proximity of a land mass and were recorded in 1937 in a trip from Suez to Abadan. It should be noted that as the vessel approached Abadan the northerly wind altered dry bulb and wet bulb conditions considerably.)

It is also interesting to note that with a thermostat set to give room conditions of, say, 80° F., fig. 3 shows there is no need to alter this setting despite the fact that a temperature differential of perhaps 20° to 30° might exist. It should therefore be pointed out that as the ambient dry bulb temperature rises above normal body temperature the wet bulb tends to fall, and thus the humidity of the outside air is considerably reduced. Under these conditions shock effect is less and the body is quite able to cope with such a temperature change. A similar drop in dry bulb temperature under more humid conditions when the ambient dry bulb temperature is, say, 90° F., might, however, cause collapse.

It can, therefore, be deduced that the shock effect depends largely on the wet bulb temperature, and with a high wet bulb temperature the dry bulb differential between outside and inside conditions should not exceed, say, 10° F.

As previously stated, when the dry bulb starts to rise in tropical conditions the wet bulb tends to fall. This is general and fortunate as otherwise people would have difficulty in surviving at all, because the body temperature could not be maintained but would start to rise to fever conditions, *i.e.* above 98·4° F. It is interesting to note that from recordings of thermostat settings on transatlantic liners over the past few years and relating these to the nationalities of people travelling, it is clear the Americans prefer a slightly cooler condition in summer and slightly warmer conditions in winter than Britons. A fuller discussion on variations of individual comfort is contained in a short paper by one of the authors.

There is one important figure in the " effective temperature " scale which has a pronounced effect on comfort. It is commonly known as the " threshold of comfort " and is 78° E.T. It has been found that below this figure 90 per cent. of people taking part in tests ceased to perspire, and as a result of this the U.S. Naval Bureau and the British Admiralty have adopted this figure as the maximum to which inside conditions shall be permitted to reach when a ship is air-conditioned. In passenger and crew accommodation for most British vessels, however, a figure between 77° E.T. and 78° E.T. is usually taken for design purposes, and associated with a reasonable outside ambient peak.

It would be incorrect to assume that such a figure produces full comfort, particularly in extended exposure, but it should be remembered that there is a certain flywheel effect from the ship and furnishings which tends to offset peak extremes, and experience has shown that figures of 74° E.T. or better are normally maintained.

Psychrometric Charts

The properties of air are easily reproduced in graphical form known as psychrometric charts and by the use of these charts it is possible to demonstrate in visual form the cycle of operations through which the air passes in doing its work through the system. These charts are also valuable in that with two known properties of air all the other properties are read direct from the chart.

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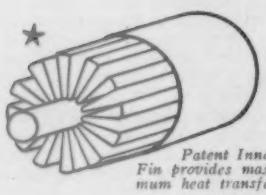

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Heating and cooling cycle diagrams are fully discussed in reference 1, and no useful purpose would be achieved by repeating the details. A psychrometric chart, however, forms part of the appendix to this paper. To date the authors have given a good deal of space to the fundamentals involved as it is only by a clear understanding of these principles that a full appreciation of the practical application can be achieved.

Calculations

The object of the initial calculation must be to create a heat balance in such a way that the air coming into the space at a definite predetermined condition, and absorbing heat from the space, will eventually arrive at the internal conditions specified.

The first problem, therefore, is to establish the heat load leaking into the space concerned, and this can be divided into the following component parts.

(1) Heat infiltration through the structure, including sun radiation, if any.
(2) Body heat, both sensible and latent.
(3) Lighting or other electric apparatus, etc., giving off heat.
(4) Fan heat (caused by work done on the air at the fan).

Consider the case of a shipboard dining saloon. Our tables give design calculation sheets for the cooling cycle and heating cycle respectively. As the cooling cycle is the more important calculation this is dealt with first. The full sensible heat load from the various sources amounts to 254,480 B.t.u. per hour, and this must be balanced by a quantity of incoming air at the right condition so that as this heat is absorbed the air arrives at the condition required within the space.

If H = sensible heat load, B.t.u. per hour.
W = weight of air in lb. per hour.
Sp = specific heat of air at constant pressure.
t_1 = temperature of incoming air, ° F.
t_2 = room temperature required, ° F.

Then the following equation must apply :—

$$W \times Sp\,(t_2 - t_1) = H$$

The object of this equation is to find the quantity of air which, when introduced into the space at a definite dew point, will then arrive at the room condition required in absorbing the sensible heat. The room condition to be maintained from the table is 82° F. D.B., 66½° F. W.B., which is a dew point of 58° F.

The first trial temperature rise, therefore, is from 58° F. to 82° F. (*i.e.* 24° F.).

This establishes the first $(t_2 - t_1)$ value in the equation.

Sp can be taken as a constant over the range of conditions normally used for air-conditioning and its value as 0·241 B.t.u. per lb. of air.

Solving the equation we have

$$W \times 0{\cdot}241 \times 24 = 254{,}480$$

$$\therefore W = \frac{254{,}480}{0{\cdot}241 \times 24}$$

Converting to c.ft. per min.

$$Q = \frac{254{,}480 \times 13{\cdot}5}{0{\cdot}241 \times 24 \times 60}$$

where 13·5 is the number of c.ft. per lb. of air at this condition.

$\therefore Q$ = 10,000 c.ft. per min. approximately.

From a study of the figures again it will be seen that 100,000 B.t.u. per hour in the form of moisture from bodies is coming into the space. This means that approximately 100 lb. of water have to be absorbed by the air every hour and this in turn means a moisture content increase of 1/6 lb. of water added to every 1,000 c.ft. of air circulated.

If, therefore, the air is introduced to the space at 58° F. dew point, the final room condition will be 82° F. and 69½° F. D.B., which is not quite the condition required. An adjustment in the entry air is necessary therefore and the dew point must be reduced to cater for the moisture pick-up. As there are disadvantages in having large temperature differentials between incoming air and the normal room condition some reheat may be necessary in this particular case.

The heating cycle will be based on the transmission figures shown by authors, which have been calculated in a similar fashion to the cooling loads but based of course on winter temperature conditions.

If the same air quantity be kept in circulation as for cooling, it is possible to calculate the temperature of the incoming air to satisfy the new equation.

$$\frac{10{,}000}{13{\cdot}5} \times 60 \times 0{\cdot}241\,(t_1 - t_2) = 43{,}640$$

$$t_1 - 70 = \frac{43{,}640 \times 13{\cdot}5}{10{,}000 \times 60 \times 0{\cdot}241}$$

$$= 4{\cdot}1° \text{ F.}$$

$$\therefore t_1 = 74{\cdot}1° \text{ F.}$$

When the outside air is particularly cold it may be necessary to add moisture to increase the humidity within the space. This is done by the direct introduction of water vapour in the form of steam and is controlled by a humidistat within the space. It will be noted that the temperature of air entering the space is not very high in view of the small sensible heat losses through the boundaries.

Naturally, however, the fresh air has to be heated from 0° to 70° F. under peak winter conditions, and the heater must therefore be designed to cater for this load as well. Similarly, from the tables, it will be obvious that the refrigerating plant and cooling coils must be capable of extracting both sensible and latent heat loads.

Design Conditions

Before the application of air-conditioning can be considered, a basis of design must be decided upon, bearing in mind the ambient conditions likely to be experienced by the vessel concerned.

The United States Naval Bureau and British Admiralty have decided that ships not normally sailing in the Red Sea or Persian Gulf routes can be covered by allowing for an outside ambient of 88° F. D.B. and 80° F. W.B. and under these conditions the inside effective temperatures should not exceed 78° E.T. It can be seen from an effective temperature chart that this allows for a drop in effective temperature of 5°. It is the authors' opinion that this is the minimum range one should consider, and if the vessel is likely to travel through the Red Sea or in the Persian Gulf an effective temperature drop of 8° to 10° should apply. A reference to the chart will show that even this is not necessarily ideal under certain peak Red Sea conditions. Results in service, however, based on these figures, have proved adequate and they do give a reasonable economic basis, allow for a certain amount of body acclimatization, and the fly wheel effect of the ship's structure and furnishings.

Design conditions suggested therefore are as follows :—

Type of ship	Outside temperatures		Inside temperatures	
	Dry bulb, °F.	Wet bulb, °F.	Dry bulb, °F.	Wet bulb, °F.
Red Sea passenger vessels	90	86	84	70
Other passenger vessels	88	80	84	70
Persian Gulf cargo vessels and tankers	90	84	84	70

It should be noted that reference is often made to " partial air-conditioning," and for this reason ambient conditions have been reduced in some cases, it being clearly understood that when outside temperature peaks occur, the inside condition may rise above 78° E.T., and will be considered as a heat wave condition. The authors feel that any reduction below the standards given above tends to destroy the value of the air-conditioning when it is most needed.

Having decided the conditions to be catered for, the actual design of plant to give the inside conditions required must be considered.

Methods of Application

It is not proposed to discuss in detail the various types of air-conditioning systems, as these have already been covered in detail by MacVicar and Fairweather. A brief résumé of the various methods of application is however given here-

with and figs. 8 to 11 inclusive show the general diagrammatic arrangements (*not given here*).

(1) *Central Station Plant*

This plant is normally best applied to public rooms and other accommodation where a zone form of control is satisfactory.

With this type of unit it is common practice to use the same heat exchanger for heating or cooling, the medium in each case being the chilled water or brine circulated from the refrigerating plant ; this avoids duplication of piping.

When heating, a calorifier is brought into circuit, and the refrigeration plant is of course out of action, and vice versa.

It will be obvious that care has to be taken to ensure that the spaces which are served by such a plant all require to be heated or cooled at the same time and it must therefore not be applied to divergent zones where it is possible in the in-between seasons that one space may require cooling while another may require to be heated.

(2) *Reheat Plant*

This plant also has a central station main system with ducts led away to the various spaces dealt with. In the branch duct systems serving the different spaces a reheater is introduced and is operated either manually or thermostatically from the space it serves.

This enables each space to be controlled independently, and because of this it will be obvious that it is ideal for cabin accommodation and living spaces generally.

It should also be noted that with this arrangement the in-between periods between summer and winter can be readily controlled.

(3) *Twin Duct System*

This arrangement again has a central station conditioner but two main ducts come from it and in the one duct a heater is inserted.

These two ducts and branch systems are then led to the various spaces concerned, and by a suitable mixing arrangement within the various spaces, either at the air terminal itself or in the duct system, a suitable mixture can be maintained thermostatically or by manual control.

Pressure controllers in the system ensure steady duct pressures.

(4) *Unit Systems*

This section has to be subdivided into several parts.

(*a*) One arrangement has a central station plant dealing with the fresh air supply in the zone concerned. Air heating/cooling units recirculate air from the room and discharge it to the room after it has passed over a suitable heater/cooler coil. While the central station unit deals with the fresh air cooling, the room unit deals with local internal sources of heating in the room itself, such as transmission lighting, body heat, etc.

(*b*) This system is like (*a*) except that the room conditioners deal with the total cooling or heating and are arranged to draw some fresh air from outside or through a supply system already fitted in the ship.

(*c*) Next comes the self-contained unit in which both refrigerating plant and air circulating unit are incorporated in the same casing. As these are housed within the spaces to be treated they are limited in capacity because of their bulk.

With the advent of the hermetic type refrigeration unit, however, a considerable advance has been made in the reduction of the bulk size and cost of this equipment, but since only an alternating current can be used with the hermetic units, rotary converters are required for d.c. ships and this detracts somewhat from their use in these cases.

(*d*) In some cases it is convenient to use direct expansion units with the condensing section outside the room treated. For practical reasons, however, it is not desirable to separate the two sections by too great a distance and a run up to 40 ft. or so of refrigeration piping between the compressor unit and evaporator in the air cooler is normal.

High Velocity or High Pressure Systems

High velocity can readily be applied to systems 1, 2, 3 and 4(*a*) but a full appreciation of all the factors involved is essential. It will be obvious that to force a quantity of air through a system at 4,000 ft. to 6,000 ft. per minute will require considerably more power than at the conventional ship velocities. This power goes into the air as heat and must be extracted by the refrigeration plant, and sound attenuation and pressure converters must be fitted to allow the air into the spaces at normal discharge velocities.

A full appraisal of this question is contained in the paper by MacVicar and Fairweather and has been given public airing in an article by W. H. Glass printed in the technical press in 1956.

To summarize the general application of air-conditioning in ships it can be said that no one method can necessarily be applied to the best advantage in all cases, and a careful study of the various aspects of each case has to be made both from the point of view of technical design, first cost and running costs.

Methods of Control

It will be appreciated that the original design is based on the likely maximum demand for heating or cooling and arrangements are made through control apparatus to deal with varying heat loads.

The systems in a modern liner are naturally of an extensive and complicated nature and in fact a paper could be written on this matter alone. However the following brief descriptions will show how the main problems are resolved.

On the cooling side, in large installations brine is circulated from a central refrigeration machinery space and the watchkeeper must ensure an adequate supply of brine at the right temperature to the system as a whole.

At the air treatment units a thermostat is fitted in the air stream directly after the cooler and this controls the flow of brine through the cooler to maintain a steady dew point temperature.

As the cooling requirement in the space decreases, a thermostat in the recirculating duct, exhaust air duct or other convenient place senses a drop in temperature and the following can be arranged.

(*a*) The thermostat can be made to modulate a cooler bypass ; or

(*b*) A reheater can be brought into operation ; or

(*c*) A direct restriction of the air quantity can be arranged.

It should be noted here that the fresh air must always pass through the cooler so that the humidity may be kept at the correct figure, but any recirculated air which is already at the correct temperature and humidity can be bypassed, thus reducing the quantity of air being cooled to a figure capable of maintaining the correct conditions on the reduced load.

With the reheat method no variation in air quantity through the cooler is arranged.

Where bypass or air quantity regulation can effectively be applied it is abviously more economical on the cooling cycle. There are advantages with the reheat method, however, as the air-conditioning unit is more simple and the careful maintenance of face and bypass dampers with their bearings and linkage gear is eradicated.

While bypass damper mechanisms can also be cut out with the restricted air method, pressure balancing devices must be incorporated so that other parts of the system do not get increased quantities of air when one section starts to close.

Furthermore, there are hygienic limits below which air quantities should not be reduced and care must be exercised therefore in the use of this method.

In cases where individual control is required to a number of spaces served by the same unit, then the reheat or twin duct systems really show considerable advantages.

Turning to the heating cycle, a direct thermostatic control of the quantity of hot brine or water to the heat exchanger can be arranged or a bypass equally well applied as for the cooling cycle. Care must be exercised with the restricted air quantity method if used to ensure effective control of the heating medium, as otherwise excessive air temperatures in ducts and at outlet can cause damage to panelling, etc., through shrinkage, etc.

Naturally, with very cold conditions, outside humidity can be very low on the heating cycle and a humidistat is normally introduced which modulates a valve on a steam spray in the air stream after the heat exchanger.

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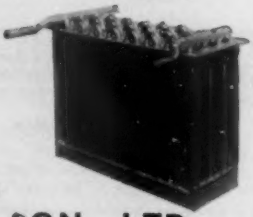

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On the small, self-contained cooling units a thermostat in the return air stream or within the room normally shuts off the refrigeration plant which restarts again through an automatic contactor starter on rise of temperature over a few degrees.

Refrigeration Plant

It will be appreciated that space does not permit a comprehensive discussion on this portion of the cooling equipment. A few comments, however, must be made on this very important part of the plant.

The advance in design of refrigeration plant over the last 30 years has been considerable, due to the discovery of new and effective refrigerants and advances in manufacturing techniques.

There are certain obvious differences between refrigeration for air-conditioning compared with its well-known application to cold storage. The refrigerant can evaporate at a higher temperature and is normally about 35° F. for a brine system and 40° to 45° F. for a direct expansion application.

The condenser is normally cooled by sea water and as such has to be of ample capacity to deal with sea water temperatures of 90° F., and also possible fouling by marine growth and dirty port water conditions.

The majority of compressor plants in service to-day for air-conditioning use " Arcton-6 " (difluordichloromethane $C.Cl_2F_2$) and this has proved effective over a considerable range of capacity. This refrigerant is very " searching " and care must be taken to ensure a " tight " system so that leakage of the refrigerant does not occur.

On modern liners where very large loads are now involved, centrifugal compressors, driven by steam turbines, are being installed. The refrigerant used in this case is " Arcton-9 " (trichlor-fluoromethane $C.Cl_3F$). This, of course, makes a flexible arrangement which will work efficiently over a considerable range of conditions, particularly with a group of similar machines fitted with speed control.

In large installations it is normal to circulate brine from one or two main sources to the various air treatment units. This involves two heat exchangers, one between the refrigerant and the brine and one between the brine and the air. Some loss of overall efficiency will be expected, therefore, and under these conditions approximately 8,000 B.t.u./hr. may be extracted for every h.p. applied to the compressor. This loss of efficiency in large installations is, however, compensated by the ease of control of the brine system circulating to large numbers of air treatment units.

It is common practice, however, on smaller plants (*e.g.* tankers) to use the refrigerant evaporator directly applied in the air stream and about 10,000 B.t.u./hr./h.p. may be obtained. The control of such equipment, however, is not as flexible as the brine method and accurate control of temperatures and humidities is more complicated.

It is known, however, that considerable research has been and is being carried out in America in an effort to obtain a suitable and easily controlled application of direct expansion to series of units over a wide area, and naturally if this can be achieved effectively a considerable gain in thermal efficiency seems possible. Perhaps those members who are intimately concerned with refrigeration may like to comment on this aspect.

Vacuum refrigeration has also been used with some success but would appear to require rather more careful maintenance than the modern " Arcton-6 " reciprocating machine. This type of plant is better suited to the larger loads, say, over 1,000,000 B.t.u./hr., although smaller plants have been fitted.

Future Developments and Conclusions

(1) It can be expected that air-conditioning will be applied to all passenger liners on an ever-increasing scale and that, except for cargo vessels operating in temperate climates only, the full treatment with refrigeration cooling equipment is to be expected.

(2) In larger vessels with larger cooling loads electrically driven refrigeration plant is likely to be superseded by turbine driven centrifugal compressors.

(3) Direct expansion refrigeration plant may perhaps supersede the present brine circulation system, provided satisfactory distribution of refrigerant together with means of local control can be obtained ; this will give an overall improvement in efficiency from the point of view of B.t.u./h.p. extracted.

(4) Active development in the early designs between naval architects, superintendent engineers and air-conditioning engineers is already well developed here, but considerably more liaison is to be expected.

(5) The use of plastic ducting on the branch duct systems, without the necessity for duct insulation, may well develop considerably and is already receiving considerable attention.

(6) Reverse cycle or heat pump application may well spread further on certain vessels depending on the main propulsion methods adopted.

(7) Large quantities of condensate from a.c. units may well be put to use in the form of boiler feed or even cooled drinking water services after suitable treatment.

(8) High duct velocities with sound and pressure converters, etc., may be used more frequently when the demand on space makes this worth while.

(9) Considerable reductions in the size and number of natural exhaust duct systems will result from full application of air-conditioning.

(10) The provision of opening ports and windows will largely disappear.

(11) The development and improvement in air terminals will largely cut out the need for quantity control, *i.e.* variation in the quantity of air delivered to cater for load variation.

References

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[2] ———. (1956). " Theory and Practice of High Velocity Sytems," " Shipbuilding and Shipping Record " International Design and Equipment Number.

[3] MacVicar, J. K. W., & Fairweather, S. T. (1956). " Marine Air-Conditioning : Some Aspects of Modern Installations." The Technical Ships Association—Oslo, February 1956.

[4] Sims, A. J. (1945). " The Habitability of Naval Ships under Wartime Conditions." Trans. I.N.A., Vol. 87, p.50.

[5] MacVicar, J. K. W. (1957). " Further Notes on Human Reactions to Tropical Conditions." Institut International du Froid, Nantes, France.

[6] Bedford, T. (1948). " Basic Principles of Ventilation and Heating." H. K. Lewis & Co., Ltd.

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NEW PUBLICATION

Single-Phase Transfer of Liquefied Gases, is the title of a new publication by Robert B. Jacobs, National Bureau of Standards, U.S.A. The greatly increased use of liquefied gases by both governmental and industrial activities has prompted an examination and re-evaluation of the basic problems connected with their handling. The current method of transporting liquefied gases over distances exceeding a few hundred feet is by mobile, insulated transport vessels. This circular examines, in detail, the feasibility of transporting liquefied gases over appreciable distances through piping systems. The problems encountered in the single-phase transfer of liquid gases are discussed in detail. A general system of equations and the empirical information required for the design of long-distance transfer systems are presented. A closed-form solution for the mathematical equations for incompressible flows is obtained and discussed. Information required for numerical computations involving helium, hydrogen, nitrogen, and oxygen is given in graphic form ; the numerical solutions for three general problems involving hydrogen and oxygen are obtained.

KEEPING OUT THE COLD

A " Winterdad " man.

Protective clothing for workers in low temperature spaces

WHILE the undertaking of any job in cold blood is most admirable if it indicates resolution of purpose, sang froid in its most literal sense need not be the outcome of entering low temperature spaces, if reasonable precautions are taken.

There is a whole host of workers up and down the country, unseen by the public and certainly unsung by them, who perform their daily chores in atmospheres which would " frighten stiff " most ordinary mortals; it is to be hoped that employers take every step to see that such men are suitably clad and protected for such work.

Well-known makers of clothing in this field, of course, are Siebe, Gorman & Co. Ltd. of Chessington, Surrey, who produce a wide variety of industrial safety apparatus and protective clothing which, incidentally, will be shown at the forthcoming Engineering, Marine, Welding and Nuclear Energy Exhibition at Olympia.

The Great Grimsby Coal, Salt and Tanning Co. Ltd. has developed an impressive range of cold store clothing which includes three distinct types. Their P.7-1 suit comprises a white Fearnought jacket, fitted with hood and belt, patch-pockets, button fastening and draw-string hood. The white Fearnought trousers to match, have whole falls, calico pockets, patches on knees. The whole suit is strongly bound and taped. Waterproof duck patch press-studded onto front is optional. The P.7-2 is similar but has fuli length (44 in. to 46 in.) coat for added protection. The P.7-3 is a one-piece Fearnought boiler-type suit.

Since the war, refrigeration in industry and commerce, especially where food storage is concerned, has gone forward at an unprecedented pace. Among the many problems facing the cold store user has been that of providing adequate protection for his operatives, who work in temperatures of –20° F. But protective clothing, in solving this problem, has also to face other difficulties, *i.e.* those of considerable

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AT A NEW LOW PRICE!

THE HUSSMANN 'CASCADE' Since it first appeared on the market over a year ago, the Hussmann 'Cascade' has earned for itself an unrivalled reputation for increasing sales wherever it is installed – in some cases by as much as 100%!

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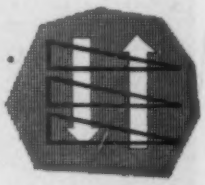
Each shelf is brightly lit from above by strip lighting and is fitted with price ticket mouldings.



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Please supply me with your revised price list and further details of Hussmann refrigerated display cases for use in the

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M.R.3.

stress on the garments, caused by continual lifting and bending; constant friction wear caused to trousers of those operatives using fork lift trucks and other forms of internal store transport, and the considerable wear to gloves involved in handling crates and packages.

Two cold stores workers clad in "Great Grimsby" suits.

This means that not only does the clothing have to protect against extreme cold, but it has to withstand seat wear, knee stress, seam strains, glove and boot wear. In addition there is an increasing demand for protective clothing to present a smart appearance, agreeable to the wearer and impressive to the visitor.

Until recently, a completely satisfactory answer was not, in all cases, easy to find. But now, one of the leading suppliers of industrial protective clothing, JCP (Industrial Clothing) Ltd. of Amersham, Bucks., has developed, after intensive research, extended trials, and full consultation with nationally known users, a complete outfit for the cold store operative, the JCP fridge suit. Already in use for the past three months by several leading cold store users, including Glacier Foods Ltd., the JCP fridge suit has demonstrated its ability to withstand temperatures down to –20°F., providing complete insulation, and all round resistance to wear.

The standard outfit comprises three-quarter length jacket, trousers, boots and gloves; a full length coat is available as an alternative. The jacket and trousers are manufactured from a heavy weight, all-wool melton material. This is completely shower proof, repelling rain, so that the operative does not experience ice-forming on his suit, on returning to the cold store from outside following exposure to inclement weather.

The jacket has a double shoulder lining, and an all-round belt, to increase efficiency of insulation. Pockets and all other edges are bound in order to prevent fraying, and the hood which constitutes a major feature of the jacket possesses a draw cord, to enable the operative to seal it round his face, so as to exclude all cold.

The trousers follow the naval pattern, with flap front and button sides. This provides added warmth for the abdomen, where cold strikes hardest. The seat is reinforced, as are the knees. All seams are turned in and double stitched, to withstand stress.

These suits can be supplied in varying weights of material, according to individual needs, and can be fully or partially lined as required. In addition, a special service available is that of silk screening the customer's name, or the trade mark of the goods handled, on the jacket-back, by a special process.

The gloves for this outfit are 14 in. top quality chrome leather with hide faced palms and backs for additional resistance to wear and tear, and they are

Cold store suit by JCP (Industrial Clothing) Ltd.

sewn with Terylene thread. They incorporate a sheepskin interlining, and a nylon lining. All stress points are strengthened.

The boots provide extreme flexibility with the necessary high degree of toughness, and insulation.

INSULATED WITH ISOCOLOR

(Photograph reproduced by courtesy of Mann Egerton & Co. Ltd., specialists in the construction of insulated and refrigerated bodies and containers.)

Manufacturers of refrigerated vans—and anyone with an interest in cold storage plant insulation—are finding out the great advantages of Isocolor expanded polystyrene. Not only does Isocolor possess the typical advantages of rigidity, stability and easy installation, but it also has the great advantage of *controlled* manufacture, which allows every stage in the making of Isocolor to be checked in the laboratory, which ensures constant insulation value. We would be pleased to send you full information and specifications. Write to the manufacturers :—

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They are calf length, in black leather, rubber soled, and sheepskin lined. An additional feature is the securely stitched leg strap.

The JCP fridge suit is one of a number of outfits developed for use in refrigerated conditions. A special one-piece garment, on the lines of a boiler suit is also available, and has been used extensively for operatives who have to work in restricted areas. This one piece fridge suit has the advantage under these conditions, of not providing any jacket flaps to catch on awkward projections or moving parts.

This suit is often supplied with a detachable hood, for further protection. It is available in three materials, wool, melton, and heavyweight kersey. In addition this suit is also showerproof. The additional silk screening service is also available on this garment. These latest developments have arisen from the need for effective cold storage clothing and JCP have been able to provide these suits as a result of discussions with cold store users. Research continues, and as other users require specialized versions of the JCP fridge suit, the firm investigates specific needs, and through the developments side of the business is constantly seeking fresh ideas for producing further developments of the fridge suit for different applications.

The glove supplied as part of the JCP fridge suit is one of a variety of patterns, in both mitt and glove form, and it has been found necessary to offer a wide range of flexibility and weight varying to the nature of the work concerned, and the temperatures undergone.

This suit, together with a full range of protective clothing supplied by the company, will be on display at the forthcoming Factory Equipment Exhibition to be held at Earls Court from April 7 to 17, 1959 (stand no. J.3.).

Winterclad Limited of Marlborough Road, Oxford, concentrate on one suit which is made in proofed cotton gaberdine and is quilted tropal-lined. The hood fastens under the chin allowing the neck portion to fall under the tunic collar. The tunic has a two button over-lapping vent to allow it to be easily pulled over the head but to retain warmth. It also has a drawstring at waist to tie at centre position, and elastic oversewn at cuffs and another drawstring at the bottom edge of the tunic. There are three pockets with flaps. A feature of this suit is that it has extremely small restrictive action on the user.

BULK STORAGE OF MILK

Bulk storage and cooling of milk in farm tanks and collection by road tanker in Great Britain was pioneered by the Scottish Milk Marketing Board. The pilot scheme was in the county of Kirkcudbright ; following on that experimental scheme, three further schemes have been developed and bulk collection is now an established method of farm collection. Data now available covering those schemes indicate that the keeping quality of milk so handled is better than by the traditional methods of cooling over a water cooler and transporting in 10-gal cans. All who have converted to bulk operations are pleased with their results and would be extremely reluctant to return to the former method. The initial Kirkcudbright scheme was followed by another by Wigtown, then in Angus and more recently in Ayr.

The Ayrshire scheme came into being on December 16, 1958, when 13 dairy farmers in Ayrshire installed bulk cooling and holding tanks and had their milk uplifted by road tanker. In Fife, a further scheme has now been approved, with 10 producers co-operating ; it is hoped this scheme will come into operation early this spring. The present Scottish position involving these four schemes can now be summarized thus : In Ayrshire there are 13 tanks, in Angus 14, in Kirkcudbright 28 and in Wigtown 12, giving a total of 67 tanks. In addition two individual producer retailers in Midlothian have installed tanks for the purpose of cooling and bulking their milk before bottling. Tanks for these schemes have been supplied by four manufacturers and the following list details the makers, size and location of the tanks now in use, giving an indication of the range and variety employed. A.P.V. supplied 12 tanks of 180-gal. and 14 tanks of 300-gal. in the Kirkcudbright scheme ; Desco supplied one 175-gal. tank, two 250-gal. and three 350-gal. tanks in Ayr and one 300-gal. tank in Angus ; Gascoigne supplied one 125-gal., three 200-gal., six 300-gal., and one 400-gal. tanks in Angus, one 175-gal. and six 250-gal. tanks in Ayr, one 125-gal. and one 400-gal. tanks in Kirkcudbright, two 200-,three 350- and one 400-gal. tanks in Wigtown, as well as supplying the two tanks in Midlothian ; Turner & Co. supplied one 150-gal. and one 400-gal. tanks in Angus, and one 300-, one 400-, one 500-, and three 600-gal. tanks in Wigtown. The tanks which were installed in the pilot scheme in Kirkcudbright and which cool the milk by means of direct expansion coils, have been superseded by tanks, which cool by a chilled water system.

L. Sterne & Co. have received an order from Greece for over 2,000 domestic refrigeration units worth more than £40,000. The order was obtained through the company's sole distributors in Greece—Mr. D. Konsta and Mr. C. Angelis—and the units will be built into Greek-made refrigerators by Isola of Athens.

Girdlestone Pumps Ltd. have produced an informative folder describing pumps for all industries. Copies may be had from their London sales office at 23, Davies Street, London, W.1.

Refrigeration Patents

These new refrigerating patents have been specially selected for readers by MODERN REFRIGERATION from the Official *Journal of Patents*, and are published by permisson of the Controller of H.M. Stationery Office.

APPLICATIONS RECEIVED

January 2—Parnall & Sons Ltd., Thompson, S. H. A., P131, Refrigerating apparatus de-frosting means. 5—Projahn, C. W., trading as Projahn-Werke Komm.Ges., C320, Refrigeration plants. 8—Southern & Redfern Ltd., Southern, A., P707, Poultry etc. freezing process. 10—Pearson, S. F., P986, Cold store construction. 13—Hughes, F. H., P1312, Refrigerating equipment. 15—Sterling Poultry Products Ltd., and Murton G. P1572, Air-conditioning apparatus. 16—Drake, F. L., P1647, Refrigerated storage cabinets. 20—Lec Refrigeration Ltd., P2011, Thermoelectric ice making machine. 23—Electrolux Ltd., C2558, Absorption refrigerating apparatus; Hunt, J. B., P2497, Air-conditioning process. 27—Borg-Warner Corporation, C2952, Ice making machine. February 2—Robertson Thain, Ltd. (Robertson Co., H. H.), C3641, Air-conditioning systems ; Searle Aircraft Sheet Metal Works, Ltd., P3560, Refrigeration apparatus drip trays. 3—Hakanssons Industrier A.B., C3814, Refrigerator apparatus device. 4—Cabot, Inc., G. L., C3895, Insulating material. 5—Sherratt, P. B., P4154, Air-conditioning heater units.

COMPLETE SPECIFICATIONS ACCEPTED

January 21—U.S. Industries, Inc., 810,479, Refrigerated storage tank ; Brown, Boveri & Cie., A. G., 810,717, Device for preparing ice-cream in refrigerators ; Dole Refrigerating Co., 810,420, Freezers. 28—English Electric Co., Ltd., 810,857, Refrigerating apparatus or hot air machine ; General Motors Corporation, 810,770, Grid-tray assembly for making ice-blocks. February 4—General Electric Co., 811,114, Dual temperature refrigeration systems ; Baader, R. G. T., 811,231, Freezing of food. 11—General Electric Co., 811,713, Dual capacity refrigeration systems ; Savage & Parsons, Ltd., 811,590, Evaporator assemblies for refrigeration systems. 18—Pressed Steel Co., Ltd., 812,068, Refrigerator cabinets ; York Shipley Limited, 811,811, Air-conditioning apparatus ; Paulucci, J. F., 811,966, Frozen food product.

New Companies

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

Carter Refrigeration & Air Conditioning Ltd., 98, Bordesley Green, Birmingham. Nominal Capital : £1,000. Secretary : J. C. Anson. Directors : John Carter, Longdon Hall, Knowle, Solihull, Warwicks ; Fredk. J. Weedman, 42, Hollybush Lane, Penn, Wolverhampton. Solicitors : Blackham Maycock and Hayward, Birmingham. Registered by Solicitors' Law Stationery Society, Ltd.

Carter Refrigeration Display Ltd., 98, Bordesley Green, Birmingham. Nominal Capital : £1,000. Directors : John Carter, Longdon Hall, Knowle, Solihull, Warwicks ; John C. Anson, 53, Grassmoor Road, Kings Norton, Birmingham, 30. Solicitors : Blackham Maycock and Hayward, Birmingham. Secretary : J. C. Anson. Registered by Solicitors' Law Stationery Society Ltd.,

Carter Thermal Engineering Ltd., 98, Bordesley Green, Birmingham. Nominal Capital : £1,000. Directors : John Carter, Longdon Hall, Knowle, Solihull, Warwicks ; Henry R. Scrivens, 1, Dale Street, Leamington, Warwicks. Solicitors : Blackham Maycock and Hayward, Birmingham. Secretary : J. C. Anson. Registered by Solicitors' Law Stationery Society, Ltd.

John Rudkin (Refrigeration) Ltd. 166, Brownlow Road, Horwich, Lancs. Secretary : Margaret M. Rudkin. Nominal Capital : £100. Directors : John Rudkin and Margaret M. Rudkin, 166, Brownlow Road, Horwich, Lancs. Registered by Manchester Office Services, Ltd.

Wathes (Distributors) Ltd., 3–7, Highcross Street, Leicester. Secretary : Janet E. M. Wathes. To carry on business of distributors, hirers, merchants of and dealers in refrigerators, etc. Nominal Capital : £1,000. Directors : Herbert S. Wathes, Forest House, Desford, Leics. ; Janet E. M. Wathes, Tamehurst, Kingsbury, nr. Tamworth, Staffs. ; Reginald W. Stanton and Donald S. Hunt. Solicitors : Owston & Co., Leicester. Registered by Jordan & Sons, Ltd.

Willsher & Quick Ltd., Market Street, Highbridge, Somerset. To carry on business of manufacturers of and dealers in air-conditioning equipment of all kinds, etc. Nominal Capital : £2,000. Directors : Leslie G. Willsher, " Endeavour," Worston Road, Highbridge ; Norman S. Quick, " Trenance," Southend Gardens, Highbridge. Registered by H. A. Just & Co., Ltd.

Palace Refrigeration (Swansea) Ltd., 90, High Street, Swansea. Secretary : Sydney Fishman. Nominal Capital : £5,000. Directors : Sydney Fishman and Mrs. Eileen M. Fishman, 19, Sketty Road, Swansea. Registered by Ronald Cross & Co., Swansea.

S. M. Modular Systems Ltd., Montgomery Chambers, Hartshead, Sheffield, 1. Secretary : Alan S. F. Ashton. To carry out the thermal and acoustic insulation of industrial and domestic buildings and buildings and structures of all kinds, and specialised insulation to boilers, refrigeration plant, etc. Nominal Capital : £3,000. Directors : Geoffrey Machin, 376, Whirlowdale Road, Sheffield, 11. ; Geo. R. Simpkin, 42, Edale Road, Sheffield, 11 ; Gladys M. Machin, Robt. H. P. Simkin, Arthur C. Kerler and Alan S. F. Ashton. Solicitors : Swann, Dodson & Co., Sheffield. Registered by Shaw & Sons, Ltd.

Deep Freeze Facilities Ltd., Shaw Mill, Newbury, Berks. Secretary : C. R. Havergall. Nominal Capital : £21,000. Permanent Directors : Eustace H. Bonnett, Burlyns, Newbury, Berks (ch.) ; Christopher R. Havergall, Tower House, Newbury, Berks. ; Christopher W. E. Collins, Woodhay Lodge, Newbury, Berks. Solicitors : Collins, Dryland & Thorowgood, Reading. Registered by Lewis Coates and Lucas, Ltd.

Refrigerator Hire Ltd., 1, Hanover Court, Hanover Square, W.1. Nominal Capital : £1,000. Miss S. A. Goy, " Old Palace Lodge," Church Street, Dunstable, signs as director Registered by Solicitors, Bernard Samuel Berrick & Co., W.1.

Medway Engineering Ltd., 22, Lowfield Street, Dartford, Kent. Secretary : D. R. St. C. Patchell. To carry on business of manufacturers of and dealers in heat exchangers, ventilating and temperature control plant, etc. Nominal Capital : £500. Directors : David R. St. C. Patchell, Cobdown, Copthall Road, Ightham, Sevenoaks ; William J. T. Blake, 18, Wimpole Street, W.1. Registered by Shaw & Sons, Ltd.

A. Atkinson & Son Ltd., 177, Manchester Road, Bradford, 5. Secretary : Irene A. Atkinson. To carry on business of heating, ventilating and air-conditioning engineers, etc. Nominal Capital : £5,000. Directors : John Atkinson and Irene A. Atkinson, " Briarbrook," Shell Lane, Calverley, Pudsey, Yorks. Registered by Gill and Thurlow, Bradford, 1.

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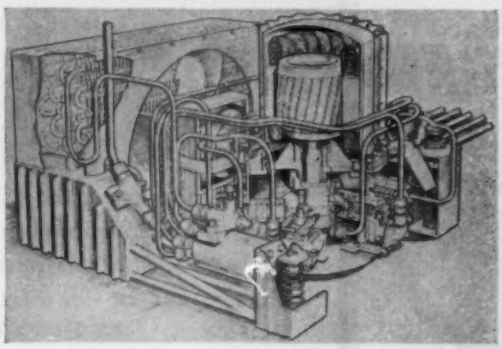

British Patent
UK 680922

Australian Patent
154195

U.S.A. Patent
2738122

New Zealand Patent
105246

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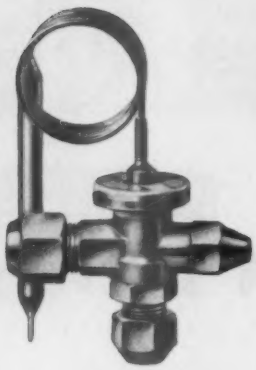

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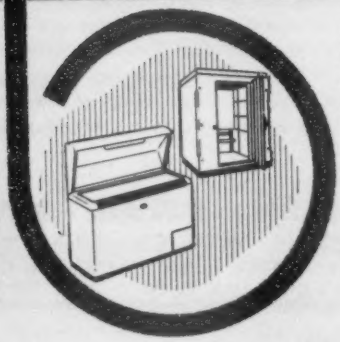

Slagbestos Mineral Wool-Felted Slabs are resilient, have greater flexibility and strength, and repel water. They are sterile, free of odour, non-hygroscopic and mould proof. Therefore Slagbestos Mineral Wool is the ideal insulation for every form of refrigeration.

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The photograph shows two compressors out of six in a two-stage installation serving a number of ice-cream hardening tunnels. The premises are those of Messrs. Nielsons (Ice Cream & Frozen Foods) Ltd., by whose courtesy this photograph is reproduced.

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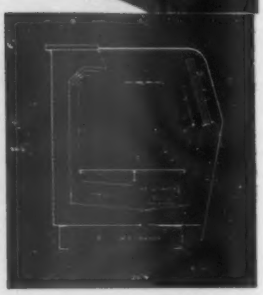

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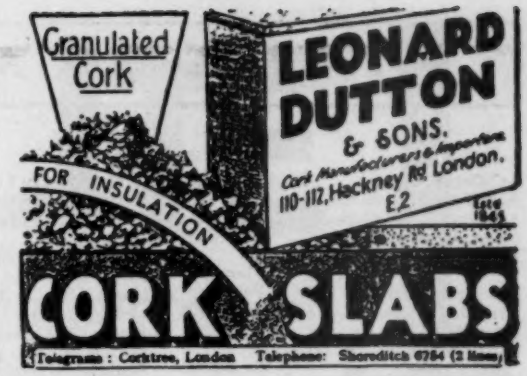

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